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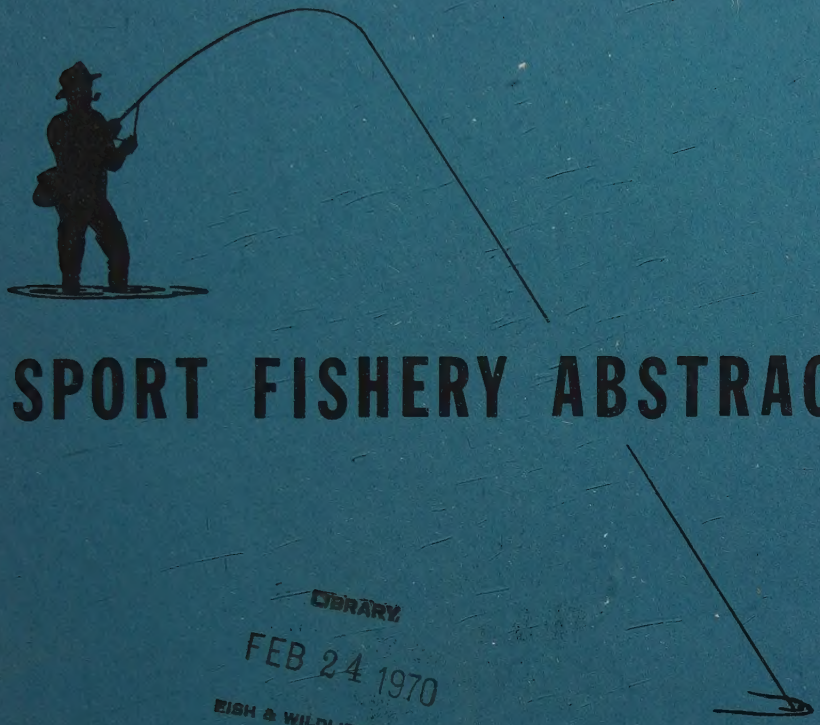

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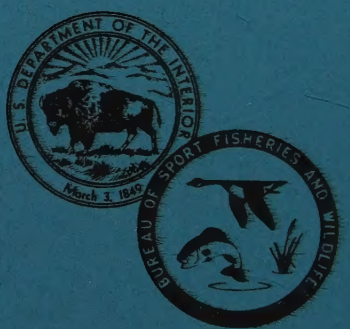

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Washington, D. C.

SPORT FISHERY ABSTRACTS

An abstracting service for fishery research and management

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Sport Fishery Abstracts is intended to furnish fishery biologists in government agencies and educational institutions with abstracts of the current literature in sport fishery research and management. Abstracts of published articles on limnology, ecology, natural history and other fields of specialization are included when the subject has application to the conservation and management of sport fishery resources.

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11001. McAllister, C. D. (Fish. Res. Board of Canada, Pacific Oceanographic Group Biological Station, Nanaimo, B. C., Canada). 1969. ASPECTS OF ESTIMATING ZOOPLANKTON PRODUCTION FROM PHYTOPLANKTON PRODUCTION. J. Fish. Res. Bd. Canada, 26(2): 199-220.

Primary productivity and zooplankton data from Ocean Station P are used to compare estimates of phytoplankton and herbivore production calculated on the assumption of continuous grazing by the animals with estimates obtained on the assumption of three different types of nocturnal grazing. Effective plant production, that corrected for the effects of grazing on the size of the phytoplankton stock and hence on the magnitude of the plant respiratory loss, was less than the measured production and was least under the assumption of continuous grazing. The small differences in effective production resulting from the choice of different grazing schemes resulted in large differences in estimates of secondary production. The relative effect of assuming different grazing schemes on the estimate of secondary production varied markedly with zooplankton respiration and with the phytoplankton growth rate. (Auth.)

11002. McDonald, J. G. (Fish. Res. Board of Canada Biological Station, Nanaimo, B. C., Canada). 1969. DISTRIBUTION, GROWTH, AND SURVIVAL OF SOCKEYE FRY (Oncorhynchus nerka) PRODUCED IN NATURAL AND ARTIFICIAL STREAM ENVIRONMENTS. J. Fish. Res. Bd. Canada, 26(2): 229-267.

A comparative study was made at Babine Lake, British Columbia, of the distribution, growth, and survival of sockeye salmon fry resulting from the same parental stock but reared in natural and artificial streams. Fry produced from natural spawning in the Fulton River and from eyed eggs planted in an adjacent artificial spawning channel were marked distinctively, released, and later recovered in the lake nursery area and at the lake outlet at time of seaward migration. Both groups dispersed rapidly and widely into the main lake basin and apparently mixed extensively with sockeye produced from other main lake tributaries. Lake distribution of marked fish, and the underyearling population as a whole, was not uniform nor static and the fish were concentrated in different lake areas at different times of their first growing season. River and channel fry were comparable in mean length at time of release but subsequently channel fish were smaller. Their smaller size appeared to result from late lake entry and a slower rate of growth for a short period thereafter. Over most of the growing period (June 25-October 25) rates of growth in length were similar (instantaneous daily rates of 0.00687 and 0.00737). No significant difference in survival rates of the two groups could be detected for the first five months of lake residence. Production of age I seaward migrants was less for river fish than for channel fish but no significance was attached to the small difference observed. These findings are discussed with respect to a fish-cultural scheme which is aimed at increasing adult production by making fuller use of the lake's capacity to rear young sockeye. (Auth.)

11003. Saunders, Richard L. (Fish. Res. Board of Canada Biological Station, St. Andrews, N. B., Canada). 1969. CONTRIBUTIONS OF SALMON FROM THE NORTHWEST MIRAMICHI RIVER, NEW BRUNSWICK, TO VARIOUS FISHERIES. J. Fish. Res. Bd. Canada, 26(2): 269-278.

Tagging studies with naturally produced smolts from the Northwest Miramichi River showed that adult salmon from this river make substantial contributions to commercial fisheries in the Miramichi area (trapnet fisheries in the Miramichi estuary and the adjoining drift-net fishery), around insular Newfoundland, and along the west coast of Greenland. Minor contributions are made to other commercial fisheries throughout the Canadian Maritime Provinces. Tagged Northwest Miramichi salmon were taken by angling in the Miramichi system only, principally the Northwest Miramichi. Commercial fisheries accounted for 32 and 87% of known recaptures of tagged grilse and larger salmon respectively; anglers, 24 and 10%; fish available for spawning, as measured by a counting fence, were 44 and 3%. The ratio of grilse to larger salmon among total recaptures was about 2:1; in fish available for spawning, about 28:1. (Auth.)

11004. Bishop, John E., and H. B. N. Hynes (Dept. of Biology, Univ. of Waterloo, Waterloo, Ont., Canada). 1969. UPSTREAM MOVEMENTS OF THE BENTHIC INVERTEBRATES IN THE SPEED RIVER, ONTARIO. J. Fish. Res. Bd. Canada, 26(2): 279-298.

Investigation of the benthic fauna of the Speed River, Ontario, was carried out from June 1966 to September 1967. Upstream movement of substantial numbers of invertebrates was detected using solid-walled traps with induced current, and Terylene net traps. The mechanism for this was largely positive rheotaxis, but positive skototaxis and the release of phototactic control probably governed the distance covered. During the winter, statistically greater movement occurred in areas adjacent to the banks than in midstream, but in summer the midstream areas contributed most of the migrants. Artificially darkening the traps increased the biomass moving into them. Movements upstream counteracted 6.5% of downstream drift by numbers and 4% by weight, but no comparison of relative distance travelled was made. The upstream movement was of sufficient quantity and species diversity to account for recolonization of dried-out or erosion-denuded areas. (Authors)

11005. Lighthart, Bruce (College of Fisheries, Univ. of Washington, Seattle, Wash.). 1969. PLANKTONIC AND BENTHIC BACTERIOVOROUS PROTOZOA AT ELEVEN STATIONS IN PUGET SOUND AND ADJACENT PACIFIC OCEAN. J. Fish. Res. Bd. Canada, 26(2): 299-304.

Bacteriovorous Protozoa and heterotrophic bacteria quantitatively cultured from 31 samples collected at eight stations in Puget Sound and three in the adjacent Pacific Ocean (one station being 1,520 cm deep) ranges from undetectable to approximately 1,000 Protozoa per ml and 5-80,000 bacteria/ml. Flagellates in the genera Bodo, Oikomonas, Monas, Rynchomonas, and Actinomonas were the most prevalent forms cultured. One ciliate and several sarcodinoids were also grown. The regression of predatory Protozoa on prey bacteria in sediment samples was calculated to be 580 bacteria for every bacteriovorous protozoan. Population densities of both bacteriovorous Protozoa and heterotrophic bacteria in the samples decreased from sediment to the water column, and from shore seaward. The ecological role of bacteriovorous Protozoa in the shallow and deep sea is discussed. (Auth.)

11006. Hopkins, Thomas L. (Marine Science Inst., Univ. of South Florida, St. Petersburg, Fla.). 1969. ZOOPLANKTON BIOMASS RELATED TO HYDROGRAPHY ALONG THE DRIFT TRACK OF ARLIS II IN THE ARCTIC BASIN AND THE EAST GREENLAND CURRENT. J. Fish. Res. Bd. Canada, 26(2): 305-310.

Zooplankton standing crop was estimated in the Arctic Basin north of Greenland and in the East Greenland Current from tows made from drifting ice island Arlis II. Number 20 mesh closing net hauls indicated that most of the zooplankton biomass was concentrated in the top 500 m in both winter and summer. The bulk of the zooplankton standing crop was copepods which contributed 86 and 77% of the biomass in the Arlis II samples from the Arctic Basin and East Greenland Current, respectively. Calanus was the most important genus, making up one-half the weight of the zooplankton. Zooplankton biomass under a square meter of sea in the top 500 m averaged 0.29 g dry weight in the Arctic Basin north of Greenland and increased to 4.52 g in the upper 500 m of the East Greenland Current. It is postulated that Arlis II was carried south near the eastern edge of the East Greenland Current and that most of the plankton occurring in the rich samples from the East Greenland Current was contributed by the Greenland Sea through vigorous mixing. (Auth.)

11007. Kabata, Z. (Fish. Res. Board of Canada, Biological Station, Nanaimo, B. C., Canada). 1969. FOUR LERNAEOPODIDAE (COPEPODA) PARASITIC ON FISHES FROM NEWFOUNDLAND AND WEST GREENLAND. J. Fish. Res. Bd. Canada, 26(2): 311-324.

Four species of copepods belonging to the family Lernaeopodidae are described. One of them (Lernaeopodina longibrachia) is new to Canada. Two (Clavella pinguis and Clavellodes rugosus) have been previously reported from Canadian waters,

though C. pinguis is very poorly known. The fourth species (Clavellomimus macruri) is placed in a newly established genus. It is concluded that the species hitherto placed in Clavellodes should be divided into three groups: one containing only C. rugosus, the second containing all species distinguished by the presence of aliform expansions at the base of the second maxillae, and the third accommodating those without such expansions. All three groups have almost identical males. (Auth.)

11008. Henderson, Nancy E., and Richard E. Peter (Dept. of Biology, Univ. of Calgary, Calgary, Alta., Canada). 1969. DISTRIBUTION OF FISHES OF SOUTHERN ALBERTA. J. Fish. Res. Bd. Canada, 26(2): 325-338.

Detailed distributions are given for 35 species of fish collected in southern Alberta. These include the first record of Moxostoma anisurum in Alberta, new records in the South Saskatchewan River drainage, and extensions of the known ranges of a number of species within the province. Records reported by earlier investigators are included with the aim of providing a complete account of the distributions of fishes in this region. (Authors)

11009. Braaten, Duane O. (Biomathematics Group, Univ. of Washington, Seattle, Wash.). 1969. ROBUSTNESS OF THE DELURY POPULATION ESTIMATOR. J. Fish. Res. Bd. Canada, 26(2): 339-355.

This is a study of the robustness, in estimating population size, of the usual DeLury Estimator and three modifications of it derived from the generalized exact deterministic catch equation of Beverton and Holt (1956, 1957). These estimators are called the Generalized DeLury Estimator, the Weighted Generalized DeLury Estimator, and the Effort-corrected DeLury Estimator. A computer was used to simulate varying environmental conditions, which included combinations of several vectors of catchability and effort and several types of random error. The results indicate that the generalized estimator is overall the best, at least for these simulated data. The effort-corrected estimator is just as effective, but requires effort correction. The usual DeLury estimator underestimates on the average. The weighted estimator has high variance. Catchability behavior has a marked effect on accuracy of any of these estimators. An increase in catchability from a previously constant level results in a subsequent increase in the estimate of population size. A decrease in catchability results in a decrease in the estimate. If catchability cycles, the estimate cycles with the same crest and period. Effort has little effect, at least for the vectors studied in this model. (Auth.)

11010. Schmidt, P. J., and E. G. Baker (Fish. Res. Board of Canada, Vancouver Lab., Vancouver, B. C., Canada). 1969. INDIRECT PIGMENTATION OF SALMON AND TROUT FLESH WITH CANTHAXANTHIN. J. Fish. Res. Bd. Canada, 26(2): 357-360.

The indirect pigmentation of the flesh of juvenile pink salmon and juvenile cutthroat and rainbow trout was achieved by incorporating the carotenoid pigment canthaxanthin with the wet food. Diets containing 190 and 450 mg of canthaxanthin per kilogram of food were fed for periods ranging from 7 to 31 weeks. When the pigmented flesh of the rainbow trout was canned and processed, the product had the appearance of processed coho salmon. Limited color measurements indicated that the induced pigmentation may be more stable to heat processing than the natural pigmentation of coho salmon. (Authors)

11011. Gray, J. R. A., and J. M. Edington (Dept. of Zoology, Univ. of Newcastle, Newcastle-upon-Tyne, England). 1969. EFFECT OF WOODLAND CLEARANCE ON STREAM TEMPERATURE. J. Fish. Res. Bd. Canada, 26(2): 399-403.

A study was made of the temperature characteristics of a stream which flowed first through open fields and then through woodland. When the woodland was felled, that section of the stream showed a marked rise in summer temperature. It is argued that the presence or absence of tree shading can be the decisive factor in determining the temperature of small streams. (Authors)

11012. Hwang, P. C., and D. R. Idler (Fish. Res. Board of Canada, Halifax Lab., Halifax, N. S., Canada). 1969. A STUDY OF MAJOR CATIONS, OSMOTIC PRESSURE, AND pH IN SEMINAL COMPONENTS OF ATLANTIC SALMON. J. Fish. Res. Bd. Canada, 26(2): 413-419.

Certain properties of semen, spermatozoa, and seminal plasma of Atlantic salmon were investigated to facilitate the development of an extender for the cryopreservation of sperm. The seminal plasma of 10 fish had an average pH of 8.25, an osmotic pressure of 232 millosmols, and contained 237, 86, 5.2, and 2.2 mg/100 g respectively of Na^+, K^+, Ca^{++}, and Mg^{++}. The corresponding values for spermatozoa were 84, 298, 1.5, and 18.7. Storage of semen at 2° C caused an increase of Na^+ and Ca^{++} and a decrease of K^+ and Mg^{++} in spermatozoa. Subsequent incubation in glucose solution did not restore ion balance in salmon spermatozoa as it did in dog spermatozoa. The results for salmon are compared with limited data for Atlantic cod. (Authors)

11013. Gardner, George R., and Paul P. Yevich (National Marine Water Quality Lab., West Kingston, R. I.). 1969. STUDIES ON THE BLOOD MORPHOLOGY OF THREE ESTUARINE CYPRINODONTIFORM FISHES. J. Fish. Res. Bd. Canada, 26(2): 433-447.

Specimens of Fundulus heteroclitus, Fundulus majalis, and Cyprinodon variegatus were bled in the field at the site of capture. Blood was obtained during all seasons and in the laboratory at intervals over a 30-day period from specimens held in two types of holding aquaria. The circulating blood elements of these three estuarine species consist of erythrocytes, small and medium lymphocytes, eosinophils, and thrombocytes. The observations were made using both stained and fresh blood preparations. Variations occurred seasonally in the morphology of erythrocytes, eosinophils, and thrombocytes. Cytoplasmic inclusions were visible in erythrocytes prior to, and at the beginning of, the new breeding season. There were changes in the refringent properties of thrombocytic and eosinophilic granules, and cyclic variations in the number of eosinophilic granules. Seasonal variations occurred in the ratio of immature to mature thrombocytes, but there was little overall variation in the ratios of leucocytic cell types. The thrombocytes were characterized by thrombocytic granulation and nuclear indentations. Thrombocytes were capable of altering their form; mature cells formed thrombocytic networks. The concentration of eosinophils gradually increased to 18% above the usual level in Fundulus heteroclitus held 30 days in 20-liter circular aquaria. The eosinophil level remained at the usual 2% in specimens held in 189-liter aquaria for the same time period. Values for specimens captured in a natural environment were also 2%. It is therefore plausible to relate the rise in eosinophils with an environmental stress associated with the circular holding containers. (Authors)

11014. Bidgood, B. F., and A. H. Berst (Dept. of Zoology, Univ. of Guelph, Guelph, Ont., Canada). 1969. LETHAL TEMPERATURES FOR GREAT LAKES RAINBOW TROUT. J. Fish. Res. Bd. Canada, 26(2): 456-459.

Samples of progeny from wild rainbow trout (Salmo gairdneri) homing to four widely separated Great Lakes watersheds, when incubated and reared under similar conditions and acclimated to 15° C, did not differ in tolerance to upper lethal temperatures. The size of the individual fish under test did not affect the resistance time. The similar response of the four samples to upper lethal temperatures complements the conclusions previously reported from phenotypic observations of wild and cultured trout from the same four watersheds. (Authors)

11015. Li, M. F., and Carol Jordan (Fish. Res. Board of Canada, Halifax, Lab., Halifax, N. S., Canada). 1969. FACTORS AFFECTING RAINBOW TROUT OVARY CELLS CULTIVATED IN VITRO. J. Fish. Res. Bd. Canada, 26(2): 461-463.

The rainbow trout ovary cells proliferated well at 18° and 23° C, and at culture medium pH value of 7.1 and 7.9. Outside these limits cell proliferation was hindered and the cellular morphology was affected significantly. The ovary cells have been shown to be susceptible to amphibian virus (LT-1). (Authors)

11016. Kalff, J. (Dept. of Zoology, McGill Univ., Montreal, Que., Canada). 1969. A DIEL PERIODICITY IN THE OPTIMUM LIGHT INTENSITY FOR MAXIMUM PHOTOSYNTHESIS IN NATURAL PHYTOPLANKTON POPULATIONS. J. Fish. Res. Bd. Canada, 26(2): 463-468.

Diurnally the optimum light intensity for maximum photosynthesis (I_{max}) of arctic pond phytoplankton was found to change from a high of approximately 0.15 ly/min during the brightest portion of the day to a low of approximately 0.03 ly/min of photosynthetically available illumination when light was minimal. It is suggested that a similarity in the I_{max} need not indicate a similarity in species composition. A maximum efficiency of light utilization (maximum carbon fixed/ly) was found at approximately 0.03 ly/min. A balance between light intensity and efficiency of light utilization determined the I_{max}. (Auth.)

11017. Musick, J.A., and K.W. Able (Virginia Inst. of Marine Science, Gloucester Point, Va.). 1969. OCCURRENCE AND SPAWNING OF THE SCULPIN Triglops murrayi (PISCES, COTIDAE) IN THE GULF OF MAINE. J. Fish. Res. Bd. Canada, 26(2): 473-475.

Triglops murrayi was taken frequently in the Gulf of Maine during all sampling seasons. Ripe individuals were taken in October and total numbers of ova ranged from 1,965 to 2,739 per female. Diameters of ova varied from 0.20 to 2.00 mm and each female may lay several complements of eggs over a long spawning season. The mode of reproduction of T. murrayi is probably similar to that of Clinocottus analis reported by Hubbs (Copeia 1966:29-42). (Authors)

11018. McKeown, B.A., and A.P. van Overbeeke (Dept. of Biological Sciences, Simon Fraser Univ., Brunaby 2, B.C., Canada). 1969. IMMUNOHISTOCHEMICAL LOCALIZATION OF ACTH AND PROLACTIN IN THE PITUITARY GLAND OF ADULT MIGRATORY SOCKEYE SALMON (Oncorhynchus nerka). J. Fish. Res. Bd. Canada, 26(7): 1837-1846.

Antibodies to porcine adrenocorticotrophic hormone (ACTH), Synacthen (synthetic corticotrophin, Ciba), and ovine prolactin were prepared in rabbits and the antisera were tested for specificity against several pituitary hormones. The gamma-globulin fractions of the antisera were conjugated with fluorescein isothiocyanate and the labelled antibodies were "purified" by column chromatography. Fresh-frozen sections of pituitary glands of adult migratory sockeye salmon were incubated with the antibody solutions and examined with a fluorescence microscope. The resulting antigen-antibody complex could be localized by re-photographing the same or alternate sections after fixation and staining. Anti-ACTH and anti-Synacthen appeared to be bound specifically by the epsilon cells, whereas anti-prolactin reacted with the eta cells of the rostral pars distalis. Pituitary glands collected at various stations along the migratory route, including one seawater sample, showed the same reactivity. Other glands were prepared for histological examination. Microspectrophotometric analysis of cell types showed that the granule density of the ACTH cells increased gradually during the later part of migration. In the prolactin cells, no change in granulation could be detected during entrance into the river or subsequent spawning migration. (Authors)

11019. Ricker, W.E. (Fish. Res. Board of Canada Biological Station, Nanaimo, B.C., Canada). 1969. EFFECTS OF SIZE-SELECTIVE MORTALITY AND SAMPLING BIAS ON ESTIMATES OF GROWTH, MORTALITY, PRODUCTION, AND YIELD. J. Fish. Res. Bd. Canada, 26(3): 479-541.

Size-selective mortality decreases or increases the actual and back-calculated lengths of an age-group, while at the same time altering the shape and variance of its length frequency distribution only slightly or not at all. An index of intensity of selection (r) can be calculated from the difference in computed length (d) between the penultimate annulus at age n and the terminal annulus at age n-1, together with the standard deviation in length (s); it is $r = 1.34d/s$, and represents the difference in mean instantaneous mortality rate between the two halves of the frequency distribution. Instantaneous rates of increase in weight can be computed from length data by multiplying the difference between the natural logarithms of length 1 year

apart by the exponent in the weight-length relationship. When there is size-selective mortality, the difference between the rate (G_X) based on observed weights in successive years differs from the true rate (G) based on the terminal length differences computed from scales. Similarly the instantaneous rate of decrease in numbers (Z) differs from the rate of loss of weight or ponderal mortality rate (Z_W). It is found that $G-G_X=Z_W-Z$. "Lee's phenomenon" may be caused by selective mortality or by biassed sampling. Unlike selective mortality, biassed sampling produces only positive Lee's phenomenon (back-calculated lengths from older fish less than those calculated from younger fish), regardless of whether it is the smaller or the larger fish that are favored by the sampling gear. The use of incorrect growth rates can lead to rather large errors in estimates of production of a stock. Errors in computation of yield, due to using numerical instead of pondreal mortality rates, tend to be much smaller. (Auth.)

11020. Leong, Roderick, J. H., and Charles P. O'Connell (Bur. of Commercial Fisheries, Fishery-Oceanography Center, La Jolla, Calif.). 1969. A LABORATORY STUDY OF PARTICULATE AND FILTER FEEDING OF THE NORTHERN ANCHOVY (Engraulis mordax). J. Fish. Res. Bd. Canada, 26(3): 557-582.

Observations of feeding behavior demonstrated that Engraulis mordax captures food by two distinctly different kinds of attack—biting and filtering. Artemia adults in high concentration evoke a biting attack and Artemia nauplii in high concentration evoke a filtering attack. Feeding trials with Artemia adults produced the equation $w = 18.1\ T^{0.359}W^{1.138}$, where w is weight of food consumed in milligrams, T is time in minutes, and W is fish weight in grams. Density had no effect over the range of 1-25 organisms per liter. Trials with adult Artemia also indicated that the maximum capacity of the digestive tract in milligrams is 93.3 W + 53.1. Feeding trials with Artemia nauplii produced the equation $n = 6.31T^{0.970}W^{0.520}D^{0.594}$, where n equals the number of nauplii consumed. Density (D) had a noticeable effect over the range 292-1120 organisms per liter. The volume of water filtered per minute was determined on the basis of this equation. The difference between the exponents for weight in the two kinds of feeding can be explained by the probability that when food is abundant filtering rate varies largely with area of mouth opening whereas particulate feeding rate varies largely with capacity. From the filtering rates determined in this study and estimates of filter food concentration in the sea it is hypothesized that E. mordax cannot obtain its daily nutritional requirement by indiscriminate filtering alone. (Authors)

11021. Brawn, V. M. (Dove Marine Lab., Univ. of Newcastle upon Tyne, Cullercoats, Northumberland, England). 1969. FEEDING BEHAVIOUR OF COD (Gadus morhua). J. Fish. Res. Bd. Canada, 26(3): 583-596.

Cod 5-90 cm long in captivity used sight to detect food in midwater. Movement of food stimulated feeding but was not essential when feeding on familiar foods. Adult cod could detect and capture falling food down to 2 mm in diameter. Large pieces of food on the bottom were found by sight but smaller pieces were taken after being detected by taste buds on the trailing barbel and pelvic fin rays. Cod were able to detect odors from many live, intact algae, invertebrates, and fish. Food below gravel or stones was located by smell and uncovered by carrying away gravel in the mouth or by rolling stones aside with the head. Food covered by sand was not found. Some live food was captured in the dark. Cod groups fed more effectively than single cod as food deeply buried was uncovered by several fish digging in the same place; food too large for one fish was pulled apart between fish and feeding behavior by one fish attracted others to the vicinity of food. Thus shoaling of cod may be advantageous to the species by enabling more food to be obtained from a given area. Larval cod reared from eggs first fed 4 days after hatching. Moving particles were followed by eye movements and captured by swimming forward and snapping if the particles moved in front of the head. Eight days after hatching the cod larvae began to feed on fine stationary particles by removing them from the respiratory water flow. (Auth.)

11022. Paterson, W. D., R. J. Douglas, I. Grinyer, and L. A. McDermott (Dept. of Microbiology, Ontario Agricultural College, Univ. of Guelph, Guelph, Ont., Canada). 1969. ISOLATION AND PRELIMINARY CHARACTERIZATION OF SOME Aeromonas salmonicida BACTERIOPHAGES. J. Fish. Res. Bd. Canada, 26(3): 629-632.

Bacteriophages for Aeromonas salmonicida were isolated from water and mud samples taken from 13 of 19 trout hatcheries and ponds examined in southern Ontario. Nine of the 13 locations were known to have histories of furunculosis disease. The bacteriophages studied formed three serological groups and two distinct morphological types. Phages of serological groups I and II possessed similar morphology; those of group III resembled the coli T-even phages. All possessed complex symmetry consisting of a head and tail with a contractile tail sheath. Latent periods of the phages ranged from 35 to 95 min and average burst sizes from 21 to 193. A group I phage and a group III phage had $S^0_{20,w}$ values of 351 and 1,000, respectively. (Authors)

11023. Beamish, R. J., and H. H. Harvey (Dept. of Zoology, Univ. of Toronto, Toronto, Ont., Canada). 1969. AGE DETERMINATION IN THE WHITE SUCKER. J. Fish. Res. Bd. Canada, 26(3): 633-638.

The purpose of this study was to test the reliability of the scale method for determining the age of white suckers. To do so, an alternative method of "aging" was explored, using sections cut from the first four rays of the pectoral fin. Two hundred and fifty white suckers were tagged, and a piece of one pectoral fin was removed before they were released. A year later, 25 were recaptured, and the rays of the remaining pectoral fin were aged. Of the recaptures, 22 showed clearly the addition of one annulus. Having confirmed the fin-ray method, the age of another 157 suckers was determined by scales and fin rays and compared. The results indicated the scale method was reliable, in this population, until the fish reach an age of 5 years. Beyond 5 years there was not close agreement between scale and fin ages. After 8 years, age as determined by scales was invariably less than from fin rays, and sometimes was in error by as much as 5 years. (Authors)

11024. Butler, D. G. (Ramsay Wright Zoological Laboratories, Univ. of Toronto, Toronto, Ont., Canada). 1969. CORPUSCLES OF STANNIUS AND RENAL PHYSIOLOGY IN THE EEL (Anguilla rostrata). J. Fish. Res. Bd. Canada, 26(3): 639-654.

In freshwater eels there is a significant correlation between glomerular filtration rates (GFR) and urine flow rates suggesting that changes in GFR rather than tubular water reabsorption lead to the major adjustments in urine flow rates accompanying changes in environmental salinity. Removal of the cropuscles of Stannius was not followed by a significant change in GFR indicating that an adequate (normal) effective filtration pressure is independent of a corpuscular pressor substance. In 8 of 17 Stanniectomised eels urine flow rates exceeded GFR demonstrating that, under these experimental conditions, eel renal tubules secrete water. Multiple tissue electrolyte changes followed Stanniectomy; the 75% increase in the plasma calcium concentration is of particular interest. This increase was probably due to a reduction in the net rate of calcium deposition in bone and not to a change in the renal handling of calcium. (Auth.)

11025. Mathisen, Ole A., and Tor Gunnerød (Fish. Res. Inst., College of Fisheries, Univ. of Washington, Seattle, Wash.). 1969. VARIANCE COMPONENTS IN THE ESTIMATION OF POTENTIAL EGG DEPOSITION OF SOCKEYE SALMON ESCAPEMENTS. J. Fish. Res. Bd. Canada, 26(3): 655-670.

The magnitude of the variance components in the estimation of the potential egg deposition of sockeye salmon escapements to the Kvichak District, Bristol Bay, Alaska, was determined from data collected from 1957 to 1966. The greatest variance component was caused by estimation of the escapement followed by the variance due to estimation of the ratio of females in the escapement. Estimation of the average fecundity added the least variance. (Authors)

11026. LaLanne, John J., and Gunnar Safsten (Bur. of Commercial Fisheries, Biological Lab., Seattle, Wash.). 1969. AGE DETERMINATION FROM SCALES OF CHUM SALMON (Oncorhynchus keta). J. Fish. Res. Bd. Canada, 26(3): 671-681.

The methodology of age determination from scales of chum salmon (Oncorhynchus keta) is reviewed. Scales from chum salmon caught in the North Pacific Ocean and streams of North America were studied. Most annuli are of two main types: a poorly formed circulus usually "cut over" by the first circulus of new growth, and what appears to be a normal circulus in the annual ring. The annulus of type 1 may be independent of the annual ring. Annuli may be at the anterior or posterior margins of the annual ring, or within it. Direct evidence that annuli are recognizable age indices was obtained from scales of marked fish. An average of 98% of the age determinations by three scale readers agreed with the known age of the fish. The time of annulus formation or start of new growth extends from as early as March to the end of June and possibly to the end of July. The ring begins to form near the end of the season (as early as August) or when new growth occurs in the spring or summer. Sometimes an annual ring is not formed. Scales taken from various parts of the body had the same number of annuli. (Authors)

11027. Kwain, Wen-hwa, and Hugh R. MacCrimmon (Dept. of Zoology, Univ. of Guelph, Guelph, Ont., Canada). 1969. AGE AND VISION AS FACTORS IN BOTTOM COLOUR SELECTION BY RAINBOW TROUT, Salmo gairdneri. J. Fish. Res. Bd. Canada, 26(3): 687-693.

Rainbow trout exposed in a circular tank to a choice of black or white bottom at a light intensity of 10^{-2} lux were randomly distributed until the age of 14 months at which time a significant preference for black began and became more pronounced with increasing age. Groups of fish (18-24 months of age) with normal eyes, without eye lenses, and lacking eyes, were held in total darkness and at 10^{-2}, 10, and 200 lux. In total darkness all groups were randomly distributed and quiescent. Fish without eye lenses selected black at all visible light intensities and acted similarly to normal fish at 10^{-2} lux. Fish lacking eyes were randomly distributed and more-or-less inactive at all intensities. The eye is essential for bottom colour discrimination and behavioral patterns occurring in normal trout exposed to different light intensities. (Authors)

11028. Saunders, J. W. (Fish. Res. Board of Canada Biological Station, St. Andrews, N. B., Canada). 1969. MASS MORTALITIES AND BEHAVIOUR OF BROOK TROUT AND JUVENILE ATLANTIC SALMON IN A STREAM POLLUTED BY AGRICULTURAL PESTICIDES. J. Fish. Res. Bd. Canada, 26(3): 695-699.

After accidental spillage of the agricultural pesticides nabam and endrin into Mill River, Prince Edward Island, there were extensive mortalities among brook trout (Salvelinus fontinalis (Mitchill)) and juvenile Atlantic salmon (Salmo salar Linnaeus). Surviving trout and salmon showed abnormal behavior including unseasonal downstream movements in summer and unusual response to an electric field. The abnormal behavior could provide a useful biological indicator of pollution by the pesticides. (Auth.)

11029. Stunkard, Horace W. (American Museum of Natural History, Central Park West at 79th Street, New York, N. Y.). 1969. THE SPOROZOA: WITH PARTICULAR REFERENCE TO INFECTIONS IN FISHES. J. Fish. Res. Bd. Canada, 26(4): 725-739.

A critical review of the Sporozoa is presented with consideration of changes in taxonomic arrangement as different morphological and developmental features have influenced opinion on systematics in the group. Infections of fishes receive primary attention, especially those produced by members of the Microsporidia. Although chiefly parasites of invertebrates, certain species cause severe infections in fishes. The bionomics, life cycles, and taxonomy of these species are still equivocal. (Auth.)

11030. Boyce, Norbert P. J. (Fish. Res. Board of Canada, Biological Station, Nanaimo, B. C., Canada). 1969. PARASITE FAUNA OF PINK SALMON (Oncorhynchus gorbuscha) OF THE BELLA COOLA RIVER, CENTRAL BRITISH COLUMBIA, DURING THEIR EARLY SEA LIFE. J. Fish. Res. Bd. Canada, 26(4): 813-820.

The acquisition of parasites by pink salmon during their initial phase of marine life is described. The parasites found were the trematodes Lecithaster gibbosus, Parahemiurus merus, and Pentagramma petrowi, the cestode Phyllobothrium sp. larva, and the nematode Contracaecum sp. larva. An attempt is made to account for the occurrence of the more predominant species, particularly the trematode L. gibbosus. (Auth.)

11031. Lawler, G. H. (Fish. Res. Board of Canada, Freshwater Inst., Winnipeg, Man., Canada). 1969. ASPECTS OF THE BIOLOGY OF Triaenophorus nodulosus IN YELLOW PERCH, Perca flavescens, IN HEMING LAKE, MANITOBA. J. Fish. Res. Bd. Canada, 26(4): 821-831.

The yellow perch, Perca flavescens, in Heming Lake, Manitoba, serves as the major second intermediate host of the pseudophyllidean cestode Triaenophorus nodulosus. A description of the cyst, plerocercoid, and invasive stages of the parasite is given. Changes in annual incidence of the parasite are recorded from an examination of 22, 696 perch captured between 1954 and 1967. The infection level of T. nodulosus in perch declined when the average size of northern pike, Esox lucius, was reduced through intensive fishing. The incidence of infection in perch is a function of size—small perch have a high incidence of infection, which gradually decreases with increasing size of perch. Particular attention is given to the occurrence of T. nodulosus in newly hatched perch; the parasites can serve as indicators of future infection levels in perch and pike. The dynamics of Triaenophorus infection is discussed. (Auth.)

11032. Tedla, Shibru, and C. H. Fernando (Dept. of Biology, Univ. of Waterloo, Waterloo, Ont., Canada). 1969. OBSERVATIONS ON THE SEASONAL CHANGES OF THE PARASITE FAUNA OF YELLOW PERCH (Perca flavescens) FROM THE BAY OF QUINTE, LAKE ONTARIO. J. Fish. Res. Bd. Canada, 26(4): 833-843.

The seasonal changes in incidence and intensity of infestation of yellow perch, Perca flavescens, by adult and larval parasites, both external and internal, were studied over a period of one year. Eight species of parasites were numerous enough to permit analysis of seasonal dynamics. Bunodera luciopercae and Echinorhynchus salmonis showed a high infestation in the fall and declined gradually to zero by late summer. New infestation occurred in early fall. Proteocephalus pearsei showed the highest incidence in summer and a lower level during the rest of the year without any marked fluctuations. The intensity of infestation remained relatively constant throughout the year. Ergasilus confusus reached its peak of incidence in the summer, declined through the fall and winter, and began increasing in spring. Intensity of infestation showed parallel changes. In February, however, both incidence and intensity were high. Diplostomulum huronense showed a high intensity of infestation in November. The incidence remained fairly constant throughout the rest of the year. Urocleidius adspectus showed no seasonal variability as regards incidence but the intensity of infestation was highest in August and September. Contracaecum spiculigerum showed no distinct seasonal changes in incidence or intensity. Glochidial infestation reached a high intensity in July. This was due to the glochidia of Lampisilis radiata siliquoidea. (Authors)

11033. Dechtiar, Alex O. (Research Branch, Ontario Dept. of Lands and Forests, Maple, Ont., Canada). 1969. TWO NEW SPECIES OF MONOGENETIC TREMATODES (TREMATODA: MONOGENEA) FROM NASAL CAVITIES OF CATOSTOMID FISHES. J. Fish. Res. Bd. Canada, 26(4): 865-869.

Pellucidhaptor catostomi n. sp., recovered from the nasal cavities of longnose suckers, Catostomus catostomus (Forster), and Pellucidhaptor nasalis n. sp., recovered from the same site in white suckers, Catostomus commersoni (Lacépède), are described. (Auth.)

11034. Freeman, Reino S., and Bruce H. Thompson (Depts. of Parasitology and Zoology, Univ. of Toronto, Toronto, Ont., Canada). 1969. OBSERVATIONS ON TRANSMISSION OF Diphyllobothrium SP. (CESTODA) TO LAKE TROUT IN ALGONQUIN PARK, CANADA. J. Fish. Res. Bd. Canada, 26(4): 871-878.

Even extensive consumption of plankton by lake trout in Algonquin Park does not always lead to infections with plerocercoids of Diphyllobothrium sp. Evidence relating to the feeding habits of these fish and the transmission of diphyllobothriid plerocercoids is discussed. Heavier infections in lake trout from certain lakes appear to be related to foraging on the less desirable fish that are available, whereas infections are rare in other lakes containing preferred prey such as perch or cisco, in spite of the fact that in both types of lakes there may be high levels of plankton consumption during the summer. It is suggested that a suitable species of first fish host probably accounts for much of the higher levels of infection in lake trout in some lakes, although direct transmission from copepods to lake trout may account for the more sparse infections in other lakes. (Authors)

11035. Margolis, L., and N. P. Boyce (Fish. Res. Board of Canada Biological Station, Nanaimo, B. C., Canada). 1969. LIFE SPAN, MATURATION, AND GROWTH OF TWO HEMIURID TREMATODES, Tubulovesicula lindbergi AND Lecithaster gibbosus, IN PACIFIC SALMON (GENUS Oncorhynchus). J. Fish. Res. Bd. Canada, 26(4): 893-907.

Studies on the life span, maturation, and growth of two trematodes of the family Hemiuridae were based on periodic sampling of two captive stocks of naturally infected pink and chum salmon. The fish were caught during their first month at sea and maintained in filtered sea water to preclude further infection. Tubulovesicula lindbergi (Layman) was found to mature in 2-4 months and live at least 31 months, growing during that time from about 0.6 mm to more than 4.5 mm; Lecithaster gibbosus (Rudolphi) matured in 1-2 weeks and had a life span of about 2-9 months, growing from 0.5 mm to almost 1.9 mm. There was considerable variation in growth rate within each species. Among specimens of L. gibbosus faster growth apparently was associated with shorter life span. Retardation of growth and maturation at high intensities of T. lindbergi infection is suggested. Evidence is presented in support of the view that the experimental results are applicable to the course of these infections in nature. (Authors)

11036. Pippy, John H. C. (Fish. Res. Board of Canada Biological Station, St. Andrews, N. B., Canada). 1969. Pomphorhynchus laevis (Zoega) Müller, 1776 (ACANTHOCEPHALA) IN ATLANTIC SALMON (Salmo salar) AND ITS USE AS A BIOLOGICAL TAG. J. Fish. Res. Bd. Canada, 26(4): 909-919.

Pomphorhynchus laevis (Zoega) Müller, 1776, an acanthocephalan, occurred in 25.4% of 974 juvenile Atlantic salmon (Salmo salar) from 18 drainage systems in the British Isles and was absent in 1,063 juvenile salmon from 36 systems in North America. Its incidence in Irish smolts was about 25 times that in Scotland, England, and Wales. A comparison of its distribution with that of potential intermediate hosts in the British Isles suggests that the amphipod Gammarus duebeni is the intermediate host in Ireland and Gammarus pulex pulex in Scotland, England, and Wales. Pomphorhynchus laevis seems to be useful for indicating the tributary of origin of salmon smolts in several Irish rivers. Its usefulness as a tag for Irish salmon on the high seas is not yet established. (Auth.)

11037. Adams, James R. (Dept. of Zoology, Univ. of British Columbia, Vancouver, B. C., Canada). 1969. MIGRATION ROUTE OF INVASIVE JUVENILE Philonema oncorhynchi (NEMATODA: PHILOMETRIDAE) IN YOUNG SALMON. J. Fish. Res. Bd. Canada, 26(4): 941-946.

The infective juveniles of the dracunculoid nematode Philonema oncorhynchi were known to reach their site of development in the wall of the swim bladder of salmon within 18 hours. To establish the route which they follow, a small, parasite-free, fingerling sockeye salmon was fed copepods containing the infective third stage of the worm. Seventeen hours later the fish was fixed, decalcified, and sectioned at 8-10 μ. The distribution of the invasive juvenile worms in the serial

transverse sections indicates that they penetrate the gut wall, mainly in the region of the pyloric caeca. The majority of juveniles reach the swim bladder by moving through the coelomic cavity; a smaller number appears to cross in the mesentery and associated tissues such as the pancreas. No evidence was found suggesting that the vascular system is used as a pathway. (Auth.)

11038. Bayless, Jack D. (South Carolina Wildlife Resour. Dept., Moncks Corner, S. C.). 1968. STRIPED BASS HATCHING AND HYBRIDIZATION EXPERIMENTS. Proc. stheast. Ass. Game Commrs., 21st Ann. Conf. pp. 233-244.

Laboratory studies to determine the effect of striped bass egg sedimentation were conducted and a mean hatch of 35.7% was recorded for eggs placed on coarse sand while eggs placed on plastic had an average hatch of 36.4%. In comparison, the average hatch on silt-sand was 13.1% and 3.2% on silt-clay-sand substrate. None of the eggs deposited on a muck-detritus substrate hatched. Further egg studies indicated that the percent hatch improved with the period of time eggs were suspended prior to sedimentation. Preliminary observations concerning white bass egg development and notes useful in approximating the time of ovulation are presented. Larvae from the striped bass female X white bass male cross are compared with larvae resulting from the reciprocal cross (white bass female X striped bass male). Meristic measurements useful in distinguishing fingerling hybrids (striped bass female X white bass male) from fingerling striped bass or white bass are listed and meristic characters for the back-cross (hybrid male X striped bass female) and the striped bass female X white bass male hybrid are described for the first time. (Auth.)

11039. Bishop, R. David (Tennessee Game and Fish Comm., Nashville, Tenn.). 1968. EVALUATION OF THE STRIPED BASS (Roccus saxatilis) AND WHITE BASS (R. chrysops) HYBRIDS AFTER TWO YEARS. Proc. stheast. Ass. Game Commrs., 21st Ann. Conf. pp. 245-254.

The initial crossings of striped bass and white bass, within a hatchery, were accomplished in April 1965. Numerous crosses were made during the 1966 and 1967 spawning seasons. The most successful crosses were obtained by fertilizing striped bass eggs with white bass sperm. The reciprocal cross has produced fry but the biologist-in-charge reported very poor survival. A release of 35,000 fry produced in 1965 into a "semi-wild" environment provided excellent results. More than 5,000 hybrids were recovered by shoreline seining prior to January 1966. Rapid growth occurred during the first two years. Individuals weighing up to 1.7 pounds at a year of age; up to 3.5 pounds at 18 months; and up to 4.8 pounds at two years were confirmed. Ripe males were taken at an age of 10-1/2 months by sport fishermen during the 1966 white bass spawning run. Some females matured the second year and were also taken during the white bass run. An estimated 2,500 fish, averaging more than two pounds, were taken by sport fishermen from the initial stocking of 35,000 fry. Reproduction was obtained from the hybrids by inducing the females to ovulate with hormone injections. Back-crosses using hybrid males and striped bass females were also successful. More than 24,000 fingerlings were produced in a 1.2 acre hatchery pond from a stocking of 40,000 fry. (Auth.)

11040. McIlwain, Thomas D. (Gulf Coast Research Lab., Ocean Springs, Miss.). 1968. DISTRIBUTION OF THE STRIPED BASS, Roccus saxatilis (Walbaum) IN MISSISSIPPI WATERS. Proc. stheast Ass. Game Commrs., 21st Ann. Conf., pp. 254-257.

Striped bass, Roccus saxatilis (Walbaum), have been reported along the Gulf Coast from Florida to eastern Louisiana. This fish has been found in all major river systems along the Mississippi Gulf Coast from the Pascagoula River west to the Tangipahoa River. The striped bass population in the west Pascagoula River supports a small sports fishery and it is the only one that consistently yields fish from year to year. The Pascagoula fish range in size up to 32 pounds in weight. In the last two years striped bass from 7 to 28 pounds have been taken in February and early March and many of the larger fish contained roe. The population level in the other rivers appears to be too low to maintain a sports fishery. There is no

concentrated effort by either sports or commercial fishermen to take striped bass in Mississippi waters and most of the striped bass now caught there are taken by fishermen while fishing for other fishes, particularly redfish (Sciaenops ocellata), or speckled trout (Cynoscion nebulosus). Auth.)

11041. Richards, C.E. (Virginia Inst. of Marine Science, Gloucester Point, Va.). 1968. ANALOG COMPUTER TECHNIQUES FOR AGE-GROWTH STUDIES OF FISHES. Proc. stheast Ass. Game Commrs., 21st Ann. Conf., pp. 273-276.

Analog computation and simulation involves the use of an electronic computer in which scaled voltages represent physical variables. This computer solves differential equations to simulate time related systems. Simulation of Von Bertalanffy's equation representing growth in length or weight is a simple procedure. Change of constant values enables a rapid adaptation and fit to a given set of growth data. A check on age analysis by using length-weight plots may be possible with this computer. An example of its use in analysis of striped bass growth is given. (Auth.)

11042. Eleuterius, Charles K., and J.Y. Christmas (Gulf Coast Research Lab., Ocean Springs, Miss.). 1968. THE DEVELOPMENT OF A TAXONOMIC CODE AND DESIGN OF A SYSTEM FOR THE ANALYSIS OF BIOLOGICAL DATA. Proc. stheast Ass. Game Commrs., 21st Ann. Conf., pp. 295-297.

The voluminous amounts of biological information collected for the Mississippi Estuarine Inventory required the development of a system for the automatic processing of this data. The prime requirement of such a system was preparing a taxonomic code that could be easily updated and efficiently handled by EDP equipment. A modified version of the phylogenetic taxonomic structure was used to reduce the extent of the code and make optimum use of computer time. By the use of several search algorithms, computer memory requirements were substantially reduced. The utilization of the coded input to present an output with scientific names rather than code eliminated the undesirable need for double reference. The necessity for the biologist to be involved directly with the processing is eliminated, thus freeing him to devote his talents to the comprehensive interpretation of the results. (Authors)

11043. Kilambi, Raj V. (Dept. of Zoology, Univ. of Arkansas, Fayetteville, Ark.). 1968. AN ANALYSIS OF THE GROWTH OF PACIFIC HERRING (Clupea pallash), LAKE STURGEON (Acipenser fluvescens) AND WHITE STURGEON (Acipenser transmontanous). BY THE PARKER-LARKIN AND VON BERTALANFFY METHODS. Proc. stheast Ass. Game Commrs., 21st Ann. Conf., pp. 297-314.

The growth of the Pacific herring (Clupea pallasii), lake sturgeon (Acipenser fulvescens) and white sturgeon (Acipenser transmontanous) is analyzed by the application of Parker-Larkin and Von Bertalanffy equations. The physiological significance of the parameters of the two equations is discussed. (Auth.)

11044. Garwood, Gordon P. (Gulf Coast Research Lab., Ocean Springs, Miss.). 1968. NOTES ON THE LIFE HISTORIES OF THE SILVERSIDES, Menidia beryllina (Cope) AND Membras martinica (Valenciennes) IN MISSISSIPPI SOUND AND ADJACENT WATER. Proc. stheast Ass. Game Commrs., 21st Ann. Conf., pp. 314-323.

During the process of a biological sampling program for Mississippi's Estuarine Inventory, data on the spawning season and influx of young were compiled for the two species of silversides found in Mississippi estuarine waters, Menidia beryllina (Cope) and Membras martinica (Valenciennes). Silversides taken from collections made with seines, beam trawls, plankton nets and dip nets were measured and the condition of the gonads noted. These data, when combined with associated field observations, first revealed ripe male and female Menidia beryllina (68 mm to 98 mm) in late March (water temperature 23.9° C) and Membras martinica (66 mm to 79 mm) early April. M. beryllina in spawning condition were collected in salinities ranging from 3.6 ‰ to 31.5 ‰ and water temperatures ranging from 23.9° C to 32.7° C throughout the spring and summer months. Spawning M. martinica were

collected in salinities from 9.4 ‰ to 31.1 ‰ and in water temperatures from 21.2° C to 30.7° C. Postlarval atherinids (4.5 mm to 9 mm) were taken in plankton tows in late March and early April. Juvenile Menidia beryllina (14 mm) first appeared in early April. Juvenile Membras martinica (26-31 mm) were first collected in early May. (Auth.)

11045. Shannon, Eugene H., and William B. Smith (Div. of Inland Fisheries, North Carolina Wildlife Resour. Comm., Raleigh, N. C.). 1968. PRELIMINARY OBSERVATIONS OF THE EFFECT OF TEMPERATURE ON STRIPED BASS EGGS AND SAC FRY. Proc. stheast Ass. Game Commrs., 21st Ann. Conf., pp. 257-260.

Data gathered at the Weldon Striped Bass Hatchery, Weldon, North Carolina, during the years 1960-1967 indicated that the optimum spawning temperature range for striped bass in the Roanoke River was between 62° F and 67° F. The minimum recorded temperature at which spawning has occurred was 55° F and the maximum was 71° F. Preliminary bioassays conducted at the hatchery during the 1967 spawning season substantiated this optimum temperature range, and further revealed that at temperatures of 74° F to 80° F, the percent hatch dropped from 80 to 60 and the frequency of dead and malformed fry increased from 48% to 100%. At these higher temperatures, none of the fry, normal nor malformed, survived for more than 70 hours after hatching. Eggs incubated and hatched, and fry held, in water at 70° F, evidenced no mortality for 76 hours following hatch. The bioassays also revealed that at water temperature ranging from 60° F to 85° F, the incubation time of striped bass eggs was reduced from 58 to 25 hours, respectively. (Authors)

11046. Logan, H. J. 1968. COMPARISON OF GROWTH AND SURVIVAL RATES OF STRIPED BASS AND STRIPED BASS X WHITE BASS HYBRIDS UNDER CONTROLLED ENVIRONMENTS. Proc. stheast Ass. Game Commrs., 21st Ann. Conf., pp. 260-263.

During the spring of 1967, 240,000 striped bass and striped bass X white bass hybrid fry were stocked in four one-acre dirt ponds. Each pond received 30,000 striped bass and 30,000 hybrids. At the end of a 71-day period, approximately 23,187 were harvested in three ponds, 12.88% of the original number. A total kill occurred in the fourth pond one week prior to harvest. Results indicate the hybrid having faster growth and higher survival rates. (Auth.)

11047. Hackney, Peter A., Walter M. Tatum, and Sam L. Spencer (Dept. of Conservation, Div. of Game and Fish, Montgomery, Ala.). 1968. LIFE HISTORY STUDY OF THE RIVER REDHORSE, Moxostoma carinatum (Cope), IN THE CAHABA RIVER, ALABAMA, WITH NOTES ON THE MANAGEMENT OF THE SPECIES AS A SPORT FISH. Proc. stheast Ass. Game Commrs., 21st Ann. Conf., pp. 324-332.

Severe reduction in number of river redhorse, Moxostoma carinatum (Cope), has occurred in Alabama and the southeast during recent years. The Cahaba River is one of the last strongholds for this species in Alabama. Electrical shocking equipment was utilized during this study. Two hundred eighty-six adult river redhorse were captured, tagged, and returned to the Cahaba River. Redhorse were observed spawning on gravel shoals during April 1966 and April 1967 with water temperatures ranging from 71° F to 76° F. Egg counts made on river redhorse ranging in size from 17.9 inches to 22.1 inches total length revealed a range from 6,078 to 23,085 eggs per individual, respectively. Pond-reared river redhorse fed heavily on the Asiatic clam, Corbicula spp. Present utilization of the river redhorse as a sport fish is light. (Authors)

11048. Mullan, James W., and Richard L. Applegate (Bur. of Sport Fisheries and Wildlife, Fayetteville, Ark.). 1968. CENTRARCHID FOOD HABITS IN A NEW AND OLD RESERVOIR DURING AND FOLLOWING BASS SPAWNING. Proc. stheast Ass. Game Commrs., 21st Ann. Conf., pp. 332-342.

Stomach contents were examined from 1,288 longear sunfish, 827 green sunfish, 1,099 bluegill, 246 largemouth bass, 144 smallmouth bass, and 304 spotted bass collected from shoreline areas of a reservoir in the process of filling and

from one 15 years old, during and following bass spawning, May 3-June 25, 1965. Young-of-the-year and bass 8.0 inches or more in length are not included. This study suggests that in the new reservoir the food supply was ample in relation to the centrarchid population demand. In the older reservoir the opposite was true, resulting in more efficient utilization of all available foods, including appreciable quantities of bass eggs and young. However, availability was influenced to a marked extent by size of predators and prey as well as abundance. The result was food "skimming", whereby the larger fish usurped the tendipedids and large cladocerans, leaving only smaller prey available for newly hatched largemouth young. (Authors)

11049. Webb, J.F., and D.D. Moss (Div. of Game and Fish, Dept. of Conservation, Montgomery, Ala.). 1968. SPAWNING BEHAVIOR AND AGE AND GROWTH OF WHITE BASS IN CENTER HILL RESERVOIR, TENNESSEE. Proc. stheast Ass. Game Commrs., 21st Ann. Conf., pp. 343-357.

The spawning behavior, age and growth and food habits of white bass, Roccus chrysops (Rafinesque), were studied in Center Hill Reservoir, Tennessee, from October 1965 until March 1967. White bass began to move toward the headwaters in late February and early March when water temperatures rose above 45° F. Spawning started in min-March at a water temperature of 53° F and appeared to stop if water temperature dropped below 53° F. The duration of the spawning season was one and one-half to two months. The growth rate of white bass was more rapid than in other waters. The maximum age of white bass in Center Hill Reservoir is eight years. The primary forage species for adult white bass were shad, Dorosoma spp. (Authors)

11050. Scott, Tom M., Jr. 1968. SPOTTED GAR PREDATION ON BLUEGILL AND SELECTED FORAGE SPECIES. Proc. stheast Ass. Game Commrs., 21st Ann. Conf., pp. 357-360.

Fingerling spotted gar, Lepisosteus oculatus (Winchell), stocked at rates of 100 and 148 per acre into four Alabama ponds containing bluegills, Lepomis macrochirus, and fathead minnows, Pimephales promelas, failed to control crowding of bluegill within a 22-month experiment. Plastic-lined pools stocked with adult gar and equal numbers of bluegills, golden shiners, Notemigonus crysoleucas, largemouth bass, Micropterus salmoides, and white catfish, Ictalurus catus, showed the least reduction in numbers of bluegill, followed by golden shiners, white catfish, and largemouth bass. An emaciated condition that developed in the largemouth bass may have contributed to their vulnerability. (Auth.)

11051. Baker, Robert F., and William P. Mathis (Arkansas Game and Fish Comm., Mountain Home, Ark.). 1968. A SURVEY OF BULL SHOALS LAKE, ARKANSAS, FOR THE POSSIBILITY OF AN EXISTING TWO-STORY LAKE SITUATION. Proc. stheast Ass. Game Commrs., 21st Ann. Conf., pp. 360-368.

The position of Bull Shoals Lake as the lower lake in a chain of four large reservoirs located on the main stem of the White River in Arkansas and Missouri is described. During the three years of 1961, 1962, and 1963, physical-chemical determinations were made at three sampling stations situated along the channel of the lake. Trout requirements with respect to temperature and dissolved oxygen as reported by other authors in the Southeastern United States are reviewed. Data collected showed that trout could survive year 'round in the vicinity of all stations. Concurrent experimental stocking of tagged rainbow trout, Salmo gairdneri (Richardson), and tag returns during this study are discussed. (Authors)

11052. Brown, James D., Charles R. Liston, and Ronald W. Dennie (Dept. of Zoology, Univ. of Arkansas, Fayetteville, Ark.). 1968. SOME PHYSICO-CHEMICAL AND BIOLOGICAL ASPECTS OF THREE COLD TAILWATERS IN NORTHERN ARKANSAS. Proc. stheast Ass. Game Commrs., 21st Ann. Conf., pp. 369-381.

Physico-chemical factors, plankton, benthic macroinvertebrates, and fishes occurring in cold tailwaters below Beaver, Bull Shoals, and Norfork dams in northern Arkansas, were sampled regularly from July 1965 through December 1966.

Physico-chemical conditions were similar in the three tailwaters throughout the study. The older tailwaters below Bull Shoals and Norfork dams were more productive than the Beaver tailwater in both phytoplankton and zooplankton. The greatest number of genera of plankton occurred in the Beaver tailwater, and the Bull Shoals tailwater had the least number. The majority of the benthic macroinvertebrates was comprised of only a few taxa. Samples from the Norfork tailwater contained more organisms and a higher average wet weight per square foot than did samples from the other two localities. Tendipedidae and Oligochaeta made up 91.0% of the total number of benthic macroinvertebrates in the Beaver tailwater; Tendipedidae and Amphipoda comprised 70.1% in the Bull Shoals tailwater. Isopoda and Tendipedidae accounted for 87.9% in the Norfork tailwater. Lists of fishes for the three tailwaters include 38 species. Five of these (Campostoma anomalum, Notropis galacturus, Notropis pilsbryi, Etheostoma caeruleum, and Cottus carolinae) were common to all three tailwaters. Cyprinids and sculpins were abundant below Bull Shoals and Norfork dams. The ichthyofauna below Beaver Dam exhibited a scarcity of cyprinids, with the exception of Campostoma anomalum, and an abundance of darters. Sculpins were rare below Beaver Dam. (Authors)

11053. Davidson, Gladney, Lloyd Posey, Jr., and Charles Hoenke. 1968. AN EVALUATION OF YO-YO FISHING. Proc. stheast Ass. Game Commrs., 21st Ann. Conf., pp. 382-391.

In Louisiana, the yo-yo fishing method has been a controversial fishing method. The yo-yo is an automatic spring loaded device equipped with a hook and when triggered by a fish will automatically set the hook and play the fish. During this project, 9,209 yo-yos were fished. The average success was 0.161 fish per effort. Approximately 21% of the yo-yos fished were tripped but caught no fish. There was little difference between day and night fishing successes. The devices were fished most efficiently during February and March. Best depths for fishing were between three and four feet. The use of sinkers greatly reduces the effectiveness of yo-yos. Based upon data gathered during this project, the yo-yo is not so efficient as popularly imagined to be and, there is no evidence that it should not be a legal fishing device. (Authors)

11054. Allen, Kenneth O., and Kirk Strawn. 1968. HEAT TOLERANCE OF CHANNEL CATFISH Ictalurus punctatus. Proc. stheast Ass. Game Commrs., 21st Ann. Conf., pp. 399-411.

Three lots of 6-day-old to 11-1/2-month-old channel catfish from a common initial source but reared under different thermal conditions were utilized to investigate several heat-tolerance relationships. During the experimental period the fish were held in constant-temperature tanks and samples of fish were subjected to a range of sub-lethal and lethal temperatures in test baths. The results were studied by plotting time to death of individual fish and means of test samples on semi-log paper, probability paper in some instances, and subjecting pertinent data to statistical analysis. Fish acclimated to 26.0, 30.0, and 34.0° C had upper lethal temperatures of approximately 36.6, 37.3, and 37.8° C, respectively. Differences in resistance times were related to age but not to size. The results of prolonged exposure to "semi-lethal" test temperatures indicated that channel catfish may die from the direct results of heat for at least 13-3/4 days after initial exposure and at slightly lower test temperatures die from the indirect results of heat, due to an increased rate of metabolism resulting in starvation. The data indicated the presence of approximately six "lethal effects" that separated the fish into physiological populations on the basis of their response to lethal temperatures. (Authors)

11055. Di Giovanni, Maria Vittoria. 1969. FIRST OBSERVATIONS ON THE GROWTH OF LARGEMOUTH-BASS (Micropterus salmoides Lacepede) IN SOME AGRICULTURAL LAKES IN UMBRIA [CENTRAL ITALY]. Riv. It. Piscic. Ittiopat., 4(2): 46-50.

11056. Bacon, Edmond J., Jr., William H. Neill, Jr., and Raj V. Kilambi. 1968. TEMPERATURE SELECTION AND HEAT RESISTANCE OF THE MOSQUITO FISH, Gambusia affinis. Proc. stheast Ass. Game Commrs., 21st Ann. Conf., pp. 411-416.

The average selected temperature of a sample of Gambusia affinis previously acclimated to 20° C decreased from 28-29° C to about 27° C after the fish had lived in a temperature-gradient tank for one month. The final thermal distribution of the fish varied with sex and developmental stage. Males selected lower temperatures than did adult females. The young fish, although more scattered than the adults, occurred mostly at temperatures higher than those selected by the adults. These results may indicate temperature separation of young and adult fish in nature which would reduce intraspecific predation and competition. Heat resistance of adult females taken from the 26.2° C-compartment of the temperature-gradient tank was higher than the resistance of 28.0° C or had a high acclimation level by temporarily venturing above 28.0° C or had accumulated high resistance by living at varying temperatures below 28.0° C. (Authors)

11057. Hoss, Donald E. (Bur. of Commercial Fisheries, Radiobiological Lab., Beaufort, N.C.). 1968. RATES OF RESPIRATION OF ESTUARINE FISH. Proc. stheast Ass. Game Commrs., 21st Ann. Conf., pp. 416-423.

A flowing-water respirometer was used to measure oxygen consumption of five species of estuarine fish: pinfish, Lagodon rhomboides; black sea bass, Centropristes striatus; Atlantic croaker, Micropogon undulatus; oyster toadfish, Opsanus tau; and mummichog, Fundulus heteroclitus. The relation between the amount of oxygen consumed and body size, in general, may be expressed by the formula $Q = a\,\text{Weight}^k$, where a and k are constants derived from experimental data for a species. Some investigators have stated that k values do not vary significantly among species of fish. In my investigations the value of k did vary significantly between certain species. The values obtained for k are given and the methods used to measure respiration rates are discussed. (Auth.)

11058. Tsai, Chu-fa (Natural Resources Inst., Univ. of Maryland, College Park, Md.). 1968. EFFECTS OF SEWAGE EFFLUENTS ON FISHES IN UPPER PATUXENT RIVER, MARYLAND. Proc. stheast Ass. Game Commrs., 21st Ann. Conf., pp. 435-

A survey on fish population was made in the upper Patuxent River, situated between the metropolitan centers of Washington, D.C. and Baltimore, Maryland, in the summer of 1966. This stream has received effluents of eight secondary domestic sewage treatment plants. Data obtained by two series of fish collections with a 10-foot and one-fourth-inch mesh seine during June 17-July 14 and August 5-24 were compared with water quality data (dissolved oxygen, conductivity, and pH). The effects of sewage effluent on the fish species diversity and fish abundance in this stream were evaluated. Results of this study indicate that chlorinated sewage effluent reduced species diversity and fish abundance immediately below the seven effluent outfalls where dissolved oxygen remained at 4.2-10.6 ppm and pH value was 6.9-8.9 (above the limit of fish tolerance). Species diversity and fish abundance gradually increased downstream below the Laurel sewage outfall (the largest) from one species and one fish to 13 species and 194 fish in a 3.6-mile section of the stream while the dissolved oxygen gradually decreased from 6.5 ppm to 3.5 ppm and the pH value only changed from 7.4 to 7.2. This demonstrates that dissolved oxygen, regarded as the most damaging factor for fish in sewage pollution, was not a decisive factor for fish distribution below a chlorinated sewage outfall. Sewage toxicity (perhaps mainly chlorination) appears to be the causative factor. (Auth.)

11059. Perry, W. Guthrie, Jr. (Louisiana Wild Life and Fisheries Commission, Grand Chenier, La.). 1968. DISTRIBUTION AND RELATIVE ABUNDANCE OF BLUE CATFISH, Ictalurus furcatus, AND CHANNEL CATFISH, Ictalurus punctatus, WITH RELATION TO SALINITY. Proc. stheast Ass. Game Commrs., 21st Ann. Conf., pp. 436-444.

A study was conducted with blue and channel catfish to determine the effect of salinity upon distribution in a tidal bayou complex on Rockefeller Refuge, Grand Chenier, Louisiana. Stations were spaced at locations from the Gulf of Mexico to Grand Lake, a large freshwater body of water which is apparently quite productive of blue and channel catfish. Collections were made primarily with an otter trawl towed for 10-minute intervals at each sampling station. Hoop nets, wire traps, trammel nets, trot lines and rotenone were used to verify trawling results. Distributional data indicated that a 2:1 ratio existed between blue and channel catfish and that they are more abundant in waters with average salinities of 3.7 and 1.7 parts per thousand, respectively. However, both species were collected from waters with salinities ranging up to 11.4 ppt. (Auth.)

11060. Broach, Richard Whitehurst (Arkansas Game and Fish Comm., Lonoke, Ark.). 1968. ARKANSAS' CATCHABLE CHANNEL CATFISH PROGRAM. Proc. stheast Ass. Game Commrs., 21st Ann. Conf., pp. 445-452.

The discreet utilization of Arkansas' expansive hatchery system has become an integral tool of the management staff of the fisheries division as related to the manipulation of a given fish population in a desired direction. As attempts at population manipulation through mass stocking of fingerling fish within existing populations became more or less universally accepted as being ineffective and incongruent with sound management principles, hatchery production, particularly of channel catfish, was slanted toward rearing of larger and older fish which would not only be less susceptible to predation, but would also create an immediate fishery where stocked. Channel catfish reared to 10 inch average total length (approximately 0.3-0.5 pounds) meet these criteria of high survival rates after stocking and of making a substantial contribution to the fishery; these channel cat are referred to as "catchables". This paper is concerned with production trends of catchable channel catfish in Arkansas' hatchery system and the correlation of this trend with an ecologically indoctrinated management program. (Auth.)

11061. Grizzell, Roy A., Jr. (Soil Conservation Service, USDA, Little Rock, Ark.). 1968. POND CONSTRUCTION AND ECONOMIC CONSIDERATIONS IN CATFISH FARMING. Proc. stheast Ass. Game Commrs., 21st Ann. Conf., pp. 459-472.

Profitable catfish farming requires careful attention to suitable water supplies; good fishpond sites; hatching, feeding, and handling fish; and adequate facilities for an orderly operation of harvesting and marketing. Good agricultural land is often suitable for catfish farming and has been widely used. Land that is poorly suited for other farm uses may also be developed into profitable ponds for raising catfish. In addition to the primary purpose of growing fish, a fish farm may provide secondary benefits such as: (1) irrigation water; (2) water for livestock; (3) feeding and resting areas for waterfowl; (4) boating; (5) fishing; (6) picnicking; and (7) water for fire fighting. (Auth.)

11062. Avault, James W., Jr., and Gilbert C. Radonski (School of Forestry and Wildlife Management, Louisiana State Univ., Baton Rouge, La.). 1968. USE OF ANTIMYCIN AS A FISH TOXICANT WITH EMPHASIS ON REMOVING TRASH FISH FROM CATFISH PONDS. Proc. stheast Ass. Game Commrs., pp. 472-475.

Antimycin was applied to five fresh-water ponds at 3, 4, or 5 ppb, and to two salt-water ponds at 10 ppb. Undesirable fish, including four centrarchids and one cyprinid, were eliminated from four of five fresh-water ponds. Undesirable fish, including a centrarchid and a livebearer, were eliminated from both salt-water ponds. Mosquitofish, Gambusia affinis, were killed in five ponds, but were eliminated in none. Channel catfish, Ictalurus punctatus, that were in four ponds, were not killed. Antimycin showed real promise as a fish toxicant particularly for removing trash fish from catfish ponds. Antimycin, under the trade name Fintrol, is registered as a fish toxicant by the Food and Drug Administration and by the U. S. Department of Agriculture. The retail cost to treat one acre-foot of water with 3 ppb antimycin was approximately $4.50. (Authors)

11063. Callaham, Mac A., and Melvin T. Huish (North Georgia College, Dahlonega, Ga.). 1968. AN EVALUATION OF ANTIMYCIN AS A SELECTIVE BLUEGILL TOXICANT UNDER VARYING CONDITIONS OF pH. Proc. stheast Ass. Game Commrs., 21st Ann. Conf., pp. 476-481.

The TL_m for bluegill and redear sunfish was determined in the laboratory using standard bioassay procedure and water from two sources. A considerably larger concentration of antimycin was required to kill fish of the same size under field conditions. Probable reasons are discussed. Selective kills of bluegill and redear were attempted in the field under pH values ranging from 6.4 to 9.6. The antimycin concentration required under these various conditions is discussed. Total kills following selective kills showed size selectivity as well as species selectivity. (Authors)

11064. Jarman, Ron, Charles Bennett, Charles Collins, and Bradford E. Brown. 1968. ANGLING SUCCESS AND RECREATIONAL USE ON TWELVE STATE-OWNED LAKES IN OKLAHOMA. Proc. stheast Ass. Game Commrs., 21st Ann. Conf., pp. 484-495.

Twelve state-owned lakes in Oklahoma were surveyed in 1965 to obtain data on sport fishing and recreational use. The lakes were virtually unmanaged and ranged in size from 26 to 180 surface acres. This project was designed to provide a basis for future management. Data was calculated on an I. B. M. 7040 computer. Average harvest in pounds per acre ranged from 22 to 107, with fishing pressure ranging from 138 to 622 hours per acre. The catch consisted mainly of largemouth bass, crappie, channel catfish, bullheads, redear sunfish and bluegill sunfish. Most of the fishing effort was expended from April through October. Other recreational use consisted mainly of sight-seeing, camping and picnicking. This usage rivaled fishing in number of participants on most lakes. (Authors)

11065. Keith, William E. 1968. TURBIDITY CONTROL AND FISH POPULATION RENOVATION ON BLUE MOUNTAIN LAKE, ARKANSAS. Proc. stheast Ass. Game Commrs., 21st Ann. Conf., pp. 495-505.

Blue Mountain Dam, a flood control project on the Petit Jean River in west central Arkansas, was completed in 1947 impounding a 2,900 acre reservoir. The reservoir is relatively shallow, receives strong wind action and has a watershed to lake area ratio of over 100:1. Since four to five years after impoundment, the lake has been plagued with heavy concentrations of colloidal turbidity and a fish population dominated by non-foragable sizes of buffalo, carp, drum and gizzard shad. Combinations of fall-winter drawdowns, commercial fishing for non-game species, a selective shad kill and the planting of rye grass in the exposed lake bed produced beneficial results in reducing colloidal turbidity and improving the fish population. However, these results were shortlived. A continuation of these efforts in a more intensive and drastic form was initiated in June, 1965. The lake was dewatered to expose 1,500 to 2,000 acres of lake bed. This area was seeded by airplane with approximately 10 tons of a mixture of Tracy sorghum, Sorghum sorghum var. Tracy, sweet sudan grass, Sorghum sorghum var. sudanensis, and a sorghum-sudan grass hybrid. Four months later, almost the entire lake bed was a dense growth of sorghum-type plants six to eight feet tall. The drawn down lake remained open to both sport and commercial fishing throughout the summer. In October of the same year, over 95% of the total fish population by weight was removed by treating the lake with 6,000 pounds of 7.6% powdered rotenone. Restocking, primarily with yearling fish, in the winter of 1965-66, totaled over one and one-third million fish. Since refilling, the lake has remained relatively clear (visibility 14 to 18 inches) except during high water, and the fish population shows rapid expansion, excellent growth and high survival. Game fishes, such as channel catfish, Ictalurus punctatus, largemouth bass, Micropterus salmoides, white bass, Roccus chrysops, and crappie, Pomoxis sp. are dominant. Through the first half of 1967, the fishermen's harvest has been excellent with reports that fishing success is similar to that experienced for the first few years after initial impoundment of the lake. (Auth.)

11066. Latapie, Walter Ralph, Jr. (Louisiana Coop. Fish. Unit., Louisiana State Univ., Baton Rouge, La.). 1968. EVALUATION OF VARIOUS TAGGING METHODS ON SEVERAL FRESHWATER FISHES AND ESTUARINE FISHES OF LOUISIANA. Proc. stheast Ass. Game Commrs., 21st Ann. Conf., pp. 505-509.

The retention rates of Atkins, dart, Petersen, spaghetti and strap tags were compared on largemouth bass, bluegill and Atlantic croaker. Antiseptics used in tagging operations were evaluated for their usefulness in promoting tag retention. Petersen and spaghetti tags were found to be the most suitable of the tags tested for bluegills in short-term studies of three months. Petersen, spaghetti and Atkins tags were found suitable for short-term tagging (3-1/2 months) with largemouth bass. None of the tags were found suitable for long-term studies with the bass. Low retention rates were shown for all tags tested at the end of seven months. Almost no retention after a five-month period was realized from Atlantic croakers. Sterilizing tags and tagging instruments with 70% isopropyl alcohol and a post-handling dip in malachite green solution were found to have no effect on growth or retention of tags on bluegills. (Auth.).

11067. Seehorn, Monte E. 1968. AN INEXPENSIVE BACKPACK SHOCKER FOR ONE-MAN USE. Proc. stheast Ass. Game Commrs., 21st Ann. Conf., pp. 516-524.

A small backpack fish shocker weighing 19 pounds was developed for use in sampling mountain trout streams on the National Forests in the Southern Appalachians. Power components include a small gasoline engine-generator combination and a step-up transformer. The completed backpack provides a choice of 125 volts, 300 volts, or 600 volts alternating current (AC). This unit is adaptable to two electrode systems. One, consisting of an aluminum dipnet and a telescoping radio antenna for the electrodes, proved most useful and versatile in the rough headwater streams sampled. With it, one man handles both the power unit and the electrodes. The other, a thirteen foot electric seine, required a larger crew but was useful in wide shallow streams. During the period April 1966-July 1967, over 100 stream fish population samples were taken in North Carolina, Virginia, and Georgia with this gear. (Auth.)

11068. Meyer, Fred P., D. Leroy Gray, William P. Mathis, J. Mayo Martin, and B.R. Wells. 1968. PRODUCTION AND RETURNS FROM THE COMMERCIAL PRODUCTION OF FISH IN ARKANSAS DURING 1966. Proc. stheast Ass. Game Commrs., 21st Ann. Conf., pp. 525-531.

Commercial fish farming is the fastest growing industry in the field of agriculture in Arkansas. Due to its fast growth, allied industries have not kept pace. Part of the difficulty has been the lack of knowledge in the right places as this industry has developed. To collect statistics on this ballooning industry, a meeting between interested agencies was held at Stuttgart, Arkansas. At this meeting a questionnaire was developed with the idea of programming the information for IBM storage. The results of the questionnaire are discussed in the paper, the information received was expanded to cover the non-responders. It is the express purpose of this paper to present an accurate estimate of the 1966 commercial fish production in the State of Arkansas. An industry as young as this one with a value of $9, 165, 000 is worth keeping tabs on. (Authors)

11069. Arnold, John G., Jr., Harry E. Schafer, and R.L. Vulliet. 1968. THE PARASITES OF THE FRESH WATER FISHES OF LOUISIANA. II. CHECK LIST OF PARASITES. Proc. stheast Ass. Game Commrs., 21st Ann. Conf., pp. 531-543.

11070. Rogers, Wilmer A. (Agricultural Experiment Station, Auburn Univ., Auburn, Ala.). 1968. FOOD HABITS OF YOUNG LARGEMOUTH BASS (Micropterus salmoides) IN HATCHERY PONDS. Proc. stheast Ass. Game Commrs., 21st Ann. Conf., pp. 543-553.

The stomachs of 525 largemouth bass fry and fingerlings were examined and the food organisms identified to genus when possible. Length and width measure-

ments were made on the food organisms to determine area and then the area was used as an index to volume. The most important food organisms were copepods, cladocerans, and midges. There was a size relationship between fish and food item with the larger fish taking a larger food item. Fish smaller than 15 millimeters in length ate copepods and cladocerans primarily while larger fish ate mostly midges. No cannibalism was detectediin the fish examined. (Auth.)

11071. Balon, Eugeniusz K. (Lab. Fish. Res., Bratislava, Czech.). 1968. NOTES TO THE ORIGIN AND EVOLUTION OF TROUTS AND SALMONS WITH SPECIAL REFERENCE TO THE DANUBIAN TROUTS. Vestn. Cesk. Spolecnosti Zool., 32(1): 1-21. Illus. Maps; Biological Abstracts, 49(17): Abst. No. 86897. 1968.

Evidence for the relationship between brown and sea trouts is discussed. The evidence and opinions on the origin of salmons and trouts are discussed, as well as those on their ancestors and early evolution. The reasons for, and time of, settling the waters of Europe are analysed. Based on the material studied, the Danube trouts are probably of western origin, i.e., the same as those from the Vistula River. There is therefore no reason for their classification into a special subspecies Salmo trutta labrax. The origin of Danubian trouts cannot be proved on the basis of their body characters alone since a detailed biometrical description of all forms of trouts living in the Danube River Basin is still missing. (From auth. summ.)

11072. Jacobs, David W., and William N. Tavolga (Dept. Anim. Behav. Amer. Mus. Natur. Hist., New York, N.Y.). 1968. ACOUSTIC FREQUENCY DISCRIMINATION IN THE GOLDFISH. Anim. Behav., 16(1): 67-71; Biological Abstracts, 49(17): Abst. No. 87313. 1968.

The capacity of the goldfish (Carassius auratus) to discriminate between two acoustic frequencies was tested by means of avoidance conditioning techniques. The pulsed-tone method was used in which the subject had to discriminate between a pulsed single frequency and pulses of two frequencies in alternation. Sound pressure levels were kept at 0 dB re 1 µb. This is equivalent to a sensation level of 40 to 45 dB at the frequencies used. Discrimination limens (JND) were determined by the staircase audiometric method. At 200 Hz, the mean JND was 9.4 Hz (4.7% difference); at 500 Hz, the mean JND was 17.4 Hz (3.5% difference); and at 1,000 Hz, the mean JND was 50.1 Hz (5.0% difference). Comparison with human frequency discrimination showed that the goldfish JND was an order of magnitude greater. The problem of frequency analysis in fish was discussed. (Authors)

11073. Fiske, John D., Clinton E. Watson, and Philip G. Coates (Div. Mar. Fish., Commonw. Mass., Boston, Mass.). 1966. A STUDY OF THE MARINE RESOURCES OF THE NORTH RIVER. Mass. Div. Mar. Fish. Monogr. Ser.

The marine resources of the North River generate significant commercial and recreational industries. A total of 34 marine finfish species were recorded in the study area. Six of these (winter flounder, striped bass, cod, pollock, mackerel, and haddock) support an intensive sport fishery. An estimated 7,000 marine fishing trips were made to the North River in 1965. Alewives, silversides, sand lance, and mummichogs were noted to be the most abundant bait, or forage, fish species inhabiting the study area. Mummichogs were taken commercially by several fishermen for sale as live bait. Recorded species which enter the coastal and offshore commercial fishery of Massachusetts include alewives, Atlantic cod, white hake, Atlantic mackerel, winter flounder, and sand lance. The North River and its tributaries support seasonal spawning populations of anadromous shad and alewives. However, because of a lack of proper management, the future success of these species in the area is jeopardized. The salt marshes bordering the North River are valuable to a multitude of fish and wildlife resources and constitute one of the largest unspoiled tide-marsh units on the coast of Massachusetts. At the present time, the North River is relatively free of polluting and contaminating substances which are detrimental to the occurrence and utilization of marine resources. (From auth. summ.)

11074. Fiske, John D., Clinton E. Watson, and Philip G. Coates (Div. Mar. Fish., Commonw. Mass., Boston, Mass.). 1967. A STUDY OF THE MARINE RESOURCES OF PLEASANT BAY. Mass. Div. Mar. Fish. Monogr. Ser. 5. 1-56. Illus.; Biological Abstracts, 49(17): Abst. No. 87416. 1968.

In 1963 an estuarine research program was initiated by the Division of Marine Fisheries. This program was designed to gather information relative to the extent and value of the marine resources of our major bays and estuaries. The investigation of Pleasant Bay, which was completed in 1966, was the seventh estuary to be evaluated under this program. A total of 36 fish species were encountered within the study area. It was noted that during the summer months the bay serves as a nursery area for the juvenile forms of important recreational and commercial fishes such as white hake, tautog, scup, cod, pollock, and alewives. During the winter and spring, the bay provides spawning habitat for large concentrations of winter flounder. An intensive sport fishery occurs within the bay for striped bass, bluefish, and winter flounder. The water quality of Pleasant Bay was found to be generally favorable to a wide variety of economic marine species. However, existing and potential sources of organic pollution threaten the continued public utilization of shellfish. (Authors)

11075. Jerome, William C., Jr., Arthur P. Chesmore, and Charles O. Anderson, Jr. (Div. Mar. Fish., Commonw. Mass., Boston, Mass.). 1966. A STUDY OF THE MARINE RESOURCES OF QUINCY BAY. Mass. Div. Mar. Fish. Monogr. Ser. 2. 1-62. Illus. Map; Biological Abstracts, 49(17): Abst. No. 87420. 1968.

Investigation of the physical and chemical characteristics of the bay, including the compilation of pertinent morphometric and water analysis data, was conducted. Investigations showed that pollution adversely affects the marine resources and the utilization and esthetic value of the area. New sewage treatment facilities should help to improve water quality of the bay and increase opportunities for all forms of marine recreation and utilization. Over 28, 400 finfish, consisting of 15 different species, were taken during shore sampling operations. Over 3, 700 finfish, consisting of 12 species, were taken during offshore sampling operations. The sport fishing industry in Quincy Bay was primarily dependent on the winter flounder, mackerel, cod and striped bass fisheries. Soft shell clam investigations, based on 234 samples, showed that over 59, 300 bushels of legal-sized clams were present in Quincy Bay. The lobster and crab fishery yielded catches valued at more than $37, 600. Twenty species of algae and three species of vascular plants were collected in the study area. Only two salt marsh areas are located within the Quincy Bay area. These areas provide nutrients to the bay and should be protected from alteration. (From auth. summ.)

11076. Jerome, William C., Jr., Arthur P. Chesmore, Charles O. Anderson, Jr., and Frank Grice (Div. Mar. Fish., Commonw. Mass., Boston, Mass.). 1965. A STUDY OF THE MARINE RESOURCES OF THE MERRIMACK RIVER ESTUARY. Mass. Div. Mar. Fish. Monogr. Ser. 1. 1-90. Illus. Maps; Biological Abstracts, 49(17): Abst. No. 87422. 1968.

Investigation of the physical and chemical characteristics of the estuary, including the compilation of pertinent morphometric and water analysis data, was completed. Investigations showed that pollution, organic and inorganic, adversely affected some of the marine resources and the utilization and esthetic value of the area. Seventeen species, comprised of over 48, 700 finfish, were taken during shore sampling operations. Nineteen species, comprised of over 2, 900 finfish, were taken during offshore sampling operations. The sport fishing industry in the Merrimack River area was primarily dependent on the striped bass, mackerel, and blackback flounder fisheries, and on the offshore ground fishery. A small but important commercial sand eel bait fishery exists in the river. From soft shell clam investigations, based on 300 cubic foot samples, it was estimated that over 73, 000 bushels of legal-sized clams were present in the estuary. An estimated 3, 000 gallons of clam worms were harvested in 1964. The lobster and crab fishery is relatively small. Fourteen species of algae and 12 species of vascular plants were collected in the study area. Recommendations are made and included in the report in an effort to aid in the protection and management of the marine resources of the Merrimack River Estuary. (From auth. summ.)

11077. Leland, John G., II. (Bears Bluff Lab., Wadmalaw Island, S. C.). 1968. A SURVEY OF THE STURGEON FISHERY OF SOUTH CAROLINA. Contrib. Bears Bluff Lab., 47. 3-27; Biological Abstracts, 49(17): Abst. No. 87426. 1968.

The sturgeon is in a critical situation in South Carolina and may disappear from the State's waters. Major enemies of the fish are shad fishermen, pollution, riverside housing developments and destruction of ecological situations necessary to the sturgeon. It is recommended that legislation be sought immediately to correct existing negative situations whenever possible and to prevent extension of man-made problems deleterious to the fish. (Auth.)

11078. Smith, Philip W. (Ill. Nat. Hist. Survey, Urbana, Ill.). 1968. AN ASSESSMENT OF CHANGES IN THE FISH FAUNA OF TWO ILLINOIS RIVERS AND ITS BEARING ON THEIR FUTURE. Trans. Ill. State Acad. Sci., 61(1): 31-52. Illus.; Biological Abstracts, 49(17): Abst. No. 87437. 1968.

Based on a comparison of fish collections taken prior to 1901 and between 1956-1966 in the Vermilion and Embarras River drainages of east-central Illinois, evidence is assembled to show one species extirpated and 20 decimated in the two systems. Analysis of factors probably responsible reveals that the principal ones are alteration of the physical habitat, e. g., rate of flow and bottom type; increase in the amount of suspended silt and subsequent loss of aquatic vegetation; and reduction in stream size and that these factors have probably been of greater significance than pollution per se in producing long-term changes in populations of stream fishes. Erection of dams and creation of artificial reservoirs have contributed most dramatically to the observed changes in the fish fauna of the two basins. An artificial reservoir contemplated for the Middle Fork will eradicate the only Illinois population of the bluebreast darter, and future reservoirs at other sites on the Embarras and Vermilion Rivers could endanger Illinois populations of the harlequin darter, eastern sand darter, dusky darter, and possibly a few other species of small fishes. (Auth.)

11079. Radzinskaya, L. I. (Severtsov Inst. Anim. Morphol., Acad. Sci. USSR, Moscow, USSR). 1966. CHANGE OF THE BLOOD INDICES OF JUVENILE AND SPAWNING NEVA SALMON (Salmo salar L.). (Izmenenie pokazatelei krovi u molodi i proizvoditelei nevskogo lososya Salmo salar L.). Vop. Ikhtion., 6(3): 568-572. Illus.; Biological Abstracts, 49(17): Abst. No. 88336. 1968.

The blood of young Atlantic salmon (S. salar) was studied from the moment of hatching to an age of 18 months and during spawning. A number of blood indices of the young salmon during the first summer of life (from the first to the fifth month) appreciably increased: concentration of blood hemoglobin, total quantity of blood and hemoglobin, and availability of hemoglobin (mg hemoglobin per g of weight). The blood indices (hemoglobin concentration, hemoglobin availability) dropped for the young fishes that wintered under ice and were completely restored only by the following fall. Probably these changes reflect a normal seasonal cycle, which is observed also under natural conditions. The high blood indices of the salmon spawners that were noted are characteristic of a few species of fishes. --J. Slep.

11080. Woodhead, P. M. J. (Heron Island Res. Stat., Great Barrier Reef, Aust.). 1968. SEASONAL CHANGES IN THE CALCIUM CONTENT OF THE BLOOD OF ARCTIC COD. J. Mar. Biol. Ass. U. K., 48(1): 81-91. Illus.; Biological Abstracts, 49(17): Abst. No. 88590. 1968.

A well-marked seasonal cycle in the total Ca content of the plasma was shown to occur in adult cod, Gadus morhua L., of both sexes: these changes were not found in juvenile, immature cod. The changes in concentration of plasma total Ca appeared to be associated with gonadal maturation, the period of hypercalcemia coinciding with the maturation cycle and the plasma Ca falling to a resting level again after spawning. Seasonal changes were greatest in the female cod and it is suggested that the raised level of Ca is associated with vitellogenesis in the ripening ovary, probably under the influence of estrogens. The cycle in the male is not yet fully understood. The formation of "rings" on otoliths and bony structures was considered in relation to changes in plasma Ca. It was concluded that the normal

cycle of annual ring formation was not accompanied by changes in the concentration of total Ca in the plasma, nor was there evidence that changes in plasma Ca were directly related to the development of "spawning zones" on the otoliths and bones of adult cod. (Auth.)

11081. Woodhead, P. M. J., and P. A. Plack (Heron Island Res. Stat., Great Barrier Reef, Aust.). 1968. ON LEVELS OF CALCIUM AND OF VITAMIN A ALDEHYDE IN THE BLOOD OF ARCTIC COD. J. Mar. Biol. Ass. U. K., 48(1): 93-96. Illus.; Biological Abstracts, 49(17): Abst. No. 88591. 1968.

Cod (Gadus morhua L.) from the Arcto-Norwegian stock were caught during their gonadal maturation cycle, and plasma samples from individual fish obtained for the determination of total Ca and vitamin A aldehyde (retinal + dehydroretinal). The concentrations of these two substances in the plasma of female cod caught during January-March were significantly correlated $r = 0.728$, $P < 0.001$, and this result supports the hypothesis that the increases in concentrations of plasma Ca and vitamin A aldehyde during the period of ovarian maturation may be controlled by the same mechanism. In September, just prior to ovarian maturation, and in October, at the beginning of maturation, there was no correlation between the concentrations of the two substances. Although some increase in concentration of plasma Ca was found in adult male cod during gonadal maturation, it was not accompanied by changes in concentration of vitamin A aldehyde in the plasma. (Authors)

11082. Edelhauser, Henry F., and Kenneth A. Siegesmund (Marquette Univ. Sch. Med., Milwaukee, Wis.). 1968. THE LOCALIZATION OF SODIUM IN THE TELEOST CORNEA. Invest. Ophthalmol., 7(2): 147-155. Illus.; Biological Abstracts, 49(17): Abst. No. 88795. 1968.

The fine structure of the brown trout cornea and its adaptional features are described. Localization of Na in these corneas is also reported. The morphological appearance of the cornea and the distribution of Na within the tissue are correlated with its impermeability of Na. (Authors)

11083. Huner, J. V., B. F. Dowden, and H. J. Bennett (Dept. Zool. and Physiol., Louisiana State Univ., Baton Rouge, La.). 1967. THE EFFECTS OF ENDRIN ON THE OXYGEN CONSUMPTION OF THE BLUEGILL SUNFISH Lepomis macrochirus. Proc. La. Acad. Sci., 30(Index 21-30): 80-86. Illus.; Biological Abstracts, 49(17): Abst. No. 89466. 1968.

The effects of sublethal (0.1 ppb) and lethal (1.0 ppb) concentrations of endrin on O_2 consumption were measured. In 5-hour and 24-hour periods, 0.1 ppb concentrations increased O_2 consumption, while 1.0 ppb lowered O_2 concentration. The effects of exercise on O_2 consumption at 0.1 ppb and 1.0 ppb concentrations were measured. The exercise factor had no significant effect on O_2 consumption, but it did affect mucus production and hastened death. (Authors)

11084. Fried, Bernard, and Richard S. Koplin (Lafayette Coll., Easton, Pa.). 1967. MORPHOLOGICAL VARIATION OF Fessisentis vancleavei Haley and Bullock 1953 (ACANTHOCEPHALA) FROM THE WHITE SUCKER, Catostomus commersoni (Lacepede). Pa. Acad. Sci. Proc., 40(2): 53-58. Illus.; Biological Abstracts, 49(17): Abst. No. 91538. 1968.

F. vancleavei from C. commersoni in Northampton County, Pennsylvania is described and illustrated and compared with the description of F. vancleavei from Lepomis gibbosus in Durham, New Hampshire. F. vancleavei from New Hampshire show little morphological variation whereas specimens from Pennsylvania vary considerably in general body size, number of longitudinal rows of hooks on the proboscis, number of hooks per row, size of lemnisci and proboscis receptacle. Comparisons of F. vancleavei and the one other member of the genus, F. fessus, are made. The genus is emended to include characteristics observed in F. vancleavei from Pennsylvania. (Authors)

11085. Hasler, Arthur D. (Dept. Zool., Univ. of Wisconsin, Madison, Wis.). 1967. UNDERWATER GUIDEPOSTS FOR MIGRATING FISHES. In: Animal orientation and navigation. Proc. 27th Ann. Biology Colloquium. May 6-7, 1966. Corvallis, Oreg. Oregon State Univ. Press: Corvallis. Oreg. State Univ. Biol. Colloq. 27. 1-20. Illus.; Biological Abstracts, 49(18): Abst. No. 92880. 1968.

11086. Takei, Makoto. 1967. STUDIES ON FISHES' FAVORITE FOODS: I. FEEDING TESTS OF CARP, YELLOWTAIL, AND RAINBOW TROUT. Bull. Tokai Reg. Fish. Res. Lab., 49. 119-129. (In Jap. with Engl. summ.); Biological Abstracts, 49(18): Abst. No. 92910. 1968.

In feeding tests of carp, an aquarium was partitioned into two parts, A and B except the bottom, for allowing the carp to swim freely from A to B and vice versa. A commercial meal as a basal fish food was put in A and a test food in B. Under these experimental conditions, the number of carp which migrated from A to B was counted and the time the fish ate the test food was recorded. Fish meat, dried mysis, shortnecked clam, commercial meal containing fish soluble, dried water fleas, milk-like flavor, sweet potato, milk, smoke flavor and butter-like flavor were preferably eaten by the carp than any other test food. Yellowtail preferred the test food mixed in commercial meal, fish meat and dried water fleas better than other test food. Rainbow trout preferred fish meat and liver, dried water fleas, extracts of bonito, bonito powder, lobster-like flavor and anise. (Auth.)

11087. Chistova, M.N. (Cent. Lab. Replenishment Fish Stocks, Leningrad, USSR). 1967. MORPHOLOGY AND CLASSIFICATION OF THE BLOOD FORMED ELEMENTS OF Oncorhynchus gorbuscha. (Morfologiya i klassifikatsiya formennykh elementov krovi gorbushi Oncorhynchus gorbuscha (Walb.). Vop. Ikhtiol., 7(1): 142-148. Illus.; Biological Abstracts, 49(18): Abst. No. 93958. 1968.

Studies were made of the blood of 41 specimens of the humpback salmon taken from the rivers Umba and Kola in July-August 1961. The samples included blood from both sexes in the IV and V stages of gonad development. The following types of cells were found: erythrocytes, lymphocytes, segmented-nucleus leukocytes, monocytoid cells, macrophages, and thrombocytes. When the usual granule-staining methods were used, the segmented-nucleus leukocytes in the cytoplasm either failed to appear at all or were visible only as indistinct grayish-purple granules. After the test for peroxidase was performed, the protoplasm of these cells was filled with sharply outlined granules. These segmented-nucleus leukocytes were classified as granulocytes. The group of monocytoid cells identified was artificial and genetically heterogeneous. (From auth. summ. transl.)

11088. Lukina, O.V. 1965. MORPHOLOGICAL FEATURES OF THE BLOOD OF PACIFIC SALMON. (Morfologicheskaya kharakteristika krovi tikhookeanskikh lososei). Sb. Nauch Tr. Vladivostok Med. Inst., 3. 109-111; From: Ref. Zh., Biol., 1966, No. 9I20. (Translation); Biological Abstracts, 49(18): Abst. No. 93966. 1968.

The blood composition of adult chum salmon was different from that of young chum in early developmental stages. A description of the shape, size and amount of particulate blood elements is presented, and the leukocyte count of adult chum, larvae and postlarvae is given. Basophils were found in larvae. In these the erythrocyte count was lower, and the monocyte count higher than in adult chum. The latter differed from young chum in having a higher erythrocyte count and lower monocyte and granular leukocyte counts.

11089. Danyulite, G.P. 1966. THE ROLE OF DIFFERENT BRANCHES OF THE NERVOUS SYSTEM IN THE ANODIC RESPONSE OF FISHES. (O roli razlichnykh otdelov nervnoi sistemy v vozniknovenii anodnoi reaktsii u ryb). Tr. Vses. Nauch-Issled Inst. Morsk. Ryb. Khoz. Okeanogr., 61: 141-150. From: Ref. Zh. Biol. 1967, No. 7I109. (Translation); Biological Abstracts, 49(18): Abst. No. 94594. 1968. The study of electrical effects on fishes poses the question whether the response of fishes to an electric current is the result of the current's direct action on the central nervous and muscular systems or a reflex phenomenon.

Experiments were made on vimba, using a direct current. The skin was anesthetized with cocaine, dicoine or magnesium sulfate, and various parts of the brain were extirpated. Experiments were also conducted with decapitated fish and with fish whose spinal cords were destroyed. The muscles were isolated from nervous effects by intramuscular injection with diplacin. The findings showed that isolation, of skin receptors had no noticeable effect on the formation of the anode reaction. Removal of the higher branches of the brain, as well as removal of the brain itself, did not prevent formation of the anode reaction. An important role in the formation of the anode reaction is played by the spinal cord. In fish with destroyed spinal cords a direct current produced only an anodic contraction. However, under the influence of separate pulses such a fish was capable of moving to the anode. This movement may be caused by the polar effect of the direct current on the motor fibers of the spinal cord.

11090. Winnicki, A. (Coll. Agr., Olszytyn-Kortowo, Poland). 1967. PLASTICITY AND HARDENING OF THE RAINBOW-TROUT EGG MEMBRANES. Bull. Acad. Pol. Sci. Ser. Sci. Biol., 15(12): 779-783. Illus.; Biological Abstracts, 49(18): Abst. No. 95474. 1968.

The final shape of the fish eggs is established immediately after fertilization, during the intake of water into the eggs followed by the hardening of the membranes. The egg membrane appears to be a highly plastic structure. This plasticity is only a temporary property of the membrane, characteristic of the hardening period. Attempts to change the shape of the eggs at a later stage have always failed. A high degree of plasticity is indicated by the fact that even the insignificant difference in specific gravity between the yolk and the perivitelline fluid causes a shortening of the vertical diameter by 4-13%. This property insures a considerable stability of equilibrium of the egg, which considerably contributes to the keeping of the embryonic disc in apical position. Due to this property the egg shape may be adapted to the conditions of the natural environment in which the eggs are normally laid. An important fact is that the egg shape established during the period of swelling and membrane hardening is retained throughout the embryonic period. This feature may be of great significance for eggs developing in natural spawning sites, protecting them against being washed out and rolled, which might during the time of increased sensitivity (blastospore closing) destroy the embryo. The location of the embryonic disc at the side of the egg (in eggs pressed between two surfaces) is interesting, though this situation might have been expected, because it was in the peripheral portion of the egg that the pressure was the weakest and there the ring-like perivitelline space was formed. (From auth.)

11091. Pilcher, K. S., Karl T. Kleeman, and J. L. Fryer (Dept. Microbiol., Oreg. State Univ., Corvallis, Oreg.). 1968. GROWTH AND GLYCOLYSIS IN TWO CELL LINES DERIVED FROM EMBRYOS OF SALMONID FISH. Proc. Soc. Exp. Biol. Med., 127(3): 659-664. Illus.; Biological Abstracts, 49(18): Abst. No. 95500. 1968.

Measurements of growth and glycolysis in two established heteroploid fibroblast-like cell lines derived from embryos of coho salmon and steelhead trout, growing at 23° C, were compared with similar measurements in cultures of a strain of diploid cells derived from human embryos, growing at 35° C. The growth rate of the coho salmon cells was nearly as great as that of the human cell strain. The rates of glucose utilization and lactic acid production by the salmonid cell lines were lower than those of the human cells. The proportion of glucose used which appeared as lactic acid in the culture medium was frequently lower in the fish cell cultures. The data obtained indicate that the process of glycolysis in these lines of salmonid fish cells proceeds in a manner very similar to that in mammalian cell cultures and that differences which exist are chiefly quantitative in nature. (Authors)

11092. Cairns, John, Jr., William T. Waller, and Jerry C. Smrchek (Dept. of Biology, Virginia Polytechnic Inst., Blacksburg, Va.). 1969. FISH BIOASSAYS CONTRASTING CONSTANT AND FLUCTUATING INPUT OF TOXICANTS. Revista de Biologia, 7(1-2): 75-91.

11093. Terner, Charles, Lavinia A. Kumar, and Tae Sik Choe (Dept. Biol., Biol. Sci. Cent., Univ., Boston, Mass.). 1968. STUDIES OF METABOLISM IN EMBRYONIC DEVELOPMENT. BIOSYNTHESIS OF LIPIDS IN EMBRYONATED TROUT OVA. Comp. Biochem. Physiol., 24(3): 941-950. Illus.; Biological Abstracts, 49(18): Abst. No. 95508. 1968.

When trout embryos were incubated with acetate-1-C^{14} for 2 hours at 25° C, the only measurable radioactivity appeared in the polyglycerophosphatide and glycolipid fractions. Incubation of embryos at 10° C for periods up to 7 days resulted in more extensive labeling of the lipids. The phospholipids were of higher specific activity than the neutral lipids. Apart from the polyglycerophosphatides, which were the most radioactive components of the phospholipids, most of remaining radioactivity of the phosphatides was localized in the cephalin fraction. Relatively little acetate was incorporated to lecithin. Of the neutral lipids the most actively labeled components were the free fatty acids, followed in decreasing specific activity by monoglycerides, diglycerides and cholesterol esters. A radioactive sphingoglycolipid was isolated and identified as ceramide galactoside. The distribution of label in the various lipid components appears to be the result of the presence in the ovum of two compartments, the yolk and the embryo. The lipids of high specific activity extracted from the ova may be assumed to be products of the metabolism of the embryo relatively undiluted by lipid pools in the yolk; the triglycerides, which are the major lipid component of the yolk, were of low specific activity. The results suggest that the lipids of the embryo are not taken up directly from the yolk, but are resynthesized by the embryo from breakdown products of the lipid reserves. (Authors)

11094. Price, Charles E. (Augusta Coll., Augusta, Ga.). 1967. NOTES ON THE TREMATODE GENERA Cleidodiscus AND Urocleidus. Quart. J. Fla. Acad. Sci., 30(1): 61-67. Illus.; Biological Abstracts, 49(18): Abst. No. 97200. 1968.

Comparative morphological studies of the monogenetic trematode genera Cleidodiscus Mueller, 1934 and Urocleidus Mueller, 1934 reveal that these included forms of both taxa are very nearly identical. The sole feature for generic separation is the possession of an accessory piece basally articulated to the cirrus of Cleidodiscus species; in Urocleidus, the accessory piece is not joined to the cirrus base. A new species, Cleidodiscus georgiensis recovered from the gills of the red-bellied sunfish, Lepomis auritus (Linnaeus), is morphologically described.

11095. Irikhimovich, A. I., and A. B. Shiryaev. 1966. SCALES AS INDICATORS OF FISH GROWTH. (Cheshuya kak indikator rosta ryb). Tr. Vses Nauch-Issled Inst. Prodovogo Ryb Khoz., 14: 95-102. From: Ref. Zh., Biol., 1967, No. 8I77. (Translation); Biological Abstracts, 49(19): Abst. No. 98229. 1968.

Comparison of the number and width of sclerites on scales showed that under favorable conditions for growth the number of sclerites decreases while their width increases.

11096. Karpus', L. T. 1967. THE USE OF A WEAK FORMALDEHYDE SOLUTION FOR Saprolegnia CONTROL. (Primenenie slavogo rastvora formalina dlya borby s saprolegniei). Tr. Tsent. Nauch-Issled Inst. Osetr. Ovogo Khoz., 1: 283-285. From: Ref. Zh., Biol., 1968, No. 2I259. (Translation); Biological Abstracts, 49(19): Abst. No. 98237. 1968.

To control Saprolegnia, which infect incubating sturgeon eggs, the water supply to the Yushchenko incubator was discontinued for 10-12 minutes and a solution of formaldehyde with NaCl was added in a concentration of 15 cm^3 of 40% formaldehyde per liter of water. At a water temperature of 16-17° C, two baths at stages 15-17 and 28-29 of maturity were sufficient; above 18° C an additional bath at stage 32 was required. The formaldehyde baths did not diminish the viability of the larvae but reduced significantly the egg mortality during the incubation period.

11097. Division of Fishery Research, Bureau of Sport Fisheries and Wildlife. 1969. PROGRESS IN SPORT FISHERY RESEARCH 1968. Bureau of Sport Fisheries and Wildlife Resource Publication 77. 259 p.

11098. Prieditis, A.R. 1966. THE REARING OF WINTER-HARDY CARP AND RAINBOW TROUT FINGERLINGS ON ARTIFICIAL FOODS WITH TRACE ELEMENTS. (Vyrashchivanie zimostoikikh segoletok karpa i raduzhnoi foreli na iskusstvennykh kormakh s mikrodobavkami). Tr. Latv. Nauch-Issled Inst. Zhivotnovod Vet., 19: 165-171 (Engl. summ). From: Ref. Zh., Biol., 1967, No. 6I230. (Translation); Biological Abstracts, 49(19): Abst. No. 98321. 1968.

Trace-elements (Co, Zn, Mn, Cu), sapropel, marine algae, antibiotics and germinating beans were added to the food of carp and rainbow fingerlings. Introduction of supplements had a favorable effect on the physiological condition of the young.

11099. Privol'nev, T.I., I.N. Ostroumova, and N.V. Koroleva. 1966. DETERMINATION OF THE PHYSIOLOGICAL STATE OF SALMON YOUNG REARED ON DIFFERENT FOOD MIXES. (Opredelenie fiziologicheskoi polnotsennosti molodi lososya pri vyrashchivanii na razhykh kormovykh smesyakh). In: Sixth session of the Scientific Council on the problem "Biological resources of Black Sea and Karelian Inland Waters". 1966. Summaries of reports. Petrozavodsk. 95-96. From: Ref. Zh., Biol., 1967, No. 8I198. (Translation); Biological Abstracts, 49(19): Abst. No. 98322. 1968.

To the basic hatchery food of salmon the following were added: for yearlings phosphatides in concentrations of 10, 15, and 20%, and chum salmon liver in concentrations of 15 and 30%; for yearlings, phosphatides, 5, 10 and 15%; sea kale 10%, cobalt chloride (2 and 4 mg per 1 kg of feed) and calcium iodide (2 mg per 1 kg of feed). Phosphatides increased the growth rate, reduced the death rate and increased the fat content, without causing either liver fat degeneration or blood pathology. Addition of 10-15% phosphatides to the feed of young salmon is recommended.

11100. Ali, M.A., and R. Crouzy (Dept. Biol. and Ecol. Optomet., Univ. Montreal, Que., Canada). 1968. ACTION SPECTRUM AND QUANTAL THRESHOLDS OF RETINOMOTOR RESPONSES IN THE BROOK TROUT, Salvelinus fontinalis (Mitchill). Z. Vergl. Physiol., 59(1): 86-89. Illus. (Ger. summ.); Biological Abstracts, 49(19): Abst. No. 99633. 1968.

The radiant energy per unit area required to trigger retinomotor responses was determined for eight wavelengths. The curve's maximum at 520 nanometres corresponds to two microwatts per steradian per square meter. The threshold requires the absorption of 7,000 quanta/sec/square degree of the field by the scotopic pigment. (Authors)

11101. Terner, Charles (Dept. Biol., Biol. Sci. Cent., Boston Univ., Boston, Mass.). 1968. STUDIES OF METABOLISM IN EMBRYONIC DEVELOPMENT. THE OXIDATIVE METABOLISM OF UNFERTILIZED AND EMBRYONATED EGGS OF THE RAINBOW TROUT. Comp. Biochem. Physiol., 24(3): 933-940. Illus.; Biological Abstracts, 49(19): Abst. No. 100711. 1968.

The changes in oxidative metabolism of trout ova between the time of fertilization and hatching, and of larvae were studied by measuring the rates of oxidation to $C^{14}O_2$ of C^{14}-labeled substrates. No measurable change of the rate of the "endogenous" respiration was observed upon addition of oxidable substrates. The rate of oxidation of acetate-1-C^{14}, pyruvate-2-C^{14} and glucose-U-C^{14} increased continuously during development. At all stages of development the rate of $C^{14}O_2$ production appeared to be the most rapid from acetate-1-C^{14}, and the slowest from glucose-U-C^{14}. Trout ova were found to carry a store of free glucose which increased as development progressed. On elimination of the glucose pool by preparation of a cell-free system consisting of mitochondria supplemented with a high-speed supernatant, the rate of utilization of added glucose exceeded that of acetate. The activities of both the glycolytic and the acetate-activating enzyme systems in the cytoplasm increased during the period of embryonic development. The ability of the ova to incorporate exogenous substrates into their endogenous reserves was demonstrated in experiments in which ova were incubated in the presence of C^{14}-labeled acetate or pyruvate for several days; subsequent incubation of the washed ova and collection of the respiratory CO_2 showed that $C^{14}O_2$ was released at linear rates over periods of several hours. (Auth.)

11102. Sherwood, R. T. 1968. ANGLING POTENTIAL IN NORTHERN IRELAND FORESTRY DIVISION WATERS. Quart. J. Forest., 62(2): 161-169. Illus.; Biological Abstracts, 49(20): Abst. No. 102968. 1968.

The Northern Ireland Agricultural Ministry's Forestry Division has many potential angling waters in its charge. The number of anglers in the British Isles is enormous and the need for new facilities is large and increasing. The development of these waters, in cooperation with the Fishery Division and the Northern Ireland Tourist Board, can provide revenue for the Forestry Division and benefit the Province. (Auth.)

11103. Le Jeune, Roger. 1967. ANADROMOUS CHAR OF KAGNERSOUALOUDJOUARK [QUEBEC, CANADA]. (L'omble chevalier anadrome du kagnersoualoudjouark). Que. Serv. Faune Bull., 10. 3-45; Biological Abstracts, 49(20): Abst. No. 103592. 1968.

The population of chars in the estuary of the Kagnersoualoudjouark River shows a propensity to be distributed according to a size gradation progressively growing, the smallest sizes being found upstream and the biggest downstream. In this estuary the same population seems to be in the same place from year to year. The mortality proportion of this population would be about 50% for the classes of otolithic age included between 11 and 15 years. There is a disparity between sexes in the growth rhythm and the mortality proportion. The mean growth of the chars population in the Kagnersoualoudjouark River can be compared advantageously to that of exotic population belonging to the same specific complex. The plasticity of the species and the diversity of media and methods of examination make difficult all attempts to define general tendencies among the quantity of forms of chars. The standardization of the methods to study chars and the normalization of the examination criteria are desirable and appear as essential conditions to continue valuable works on this fish. (Auth. summ. transl.)

11104. Long, Don M., Thomas S. Rodenheimer, J. Francis Hartmann, and Igor Klatzo (Br. Surg. Neurol., Natl. Inst. Neurol. Dis. and Blindness, Bethesda, Md.). 1968. ULTRASTRUCTURAL FEATURES OF THE SHARK BRAIN. Amer. J. Anat., 122(2): 209-236. Illus.; Biological Abstracts, 49(20): Abst. No. 103864. 1968.

The ultrastructural characteristics of elasmobranch central nervous system have not been previously reported. This study presents a general assessment of aldehyde perfused brain and spinal cord in three species of shark: tiger (Galeocerdo cuvieri), smooth hammerhead (Sphyrna zygaena) and nurse (Ginglymostoma cirratum). The same distinct cell types are present in the shark that exist in mammals and similar criteria may be used for their differentiation. Neurons have frequently round nuclei with a prominent nucleoli; cytoplasm is abundant and filled with formed elements; somatic synapses and subsurface cisterns are rare. Astrocytes are smaller, and have less cytoplasm and slightly fewer organelles. Glial fibrils occur, but are not invariably present. Separating astrocytes from neurons is the most difficult identification problem. Oligodendrogliocytes are smaller, and have denser cytoplasm and a dark nucleus. The striking feature of capillary morphology is the presence of an appreciable perivascular space containing collagen; many tortuous evaginations of this space occur into surrounding glial processes which completely invest the capillaries. Astrocyte cell bodies frequently lie immediately next to vessels, and capillaries are occasionally totally surrounded by a single astrocyte process, thus being endocellular. Smaller pericapillary processes may be either astrocytic or ependymal. Dendrites, synapses, axons, and myelin have no obvious special characteristics. Sodium, visualized by precipitation techniques, is prominent in the astroglia and neurons. (Authors)

11105. Medcof, J. Carl (Fish. Res. Board of Canada Biological Station, St. Andrews, N. B., Canada). 1969. FISHERMEN'S REPORTS OF FRESHWATER AND SALTWATER MIGRATIONS OF NOVA SCOTIA EELS (Anguilla rostrata). Can. Field Nat., 83(2): 132-138.

11106. Massey, B. D., and C. L. Smith (Dept. Zool. and Comp. Physiol., Univ., Birmingham, England). 1968. THE ACTION OF THYROXINE [T_4] ON MITOCHONDRIAL RESPIRATION AND PHOSPHORYLATION IN THE TROUT (Salmo trutta fario L.). Comp. Biochem. Physiol., 25(1): 241-255. Illus.; Biological Abstracts, 49(20): Abst. No. 140785. 1968.

The growth rate of brown trout increased when T_4 was added to the tank water at or above a concentration of 3.75 μM; but declined again when the concentration was raised to 12.75 μM. Mitochondria isolated from trout treated with 3.75 μM T_4 for at least 14 days showed decreased phosphorylatory efficiency and increased specific activity of oxidative enzyme systems; thiourea treatment tended to reverse these results. T_4 administered in vitro to mitochondria from untreated fish uncoupled oxidation and phosphorylation at concentrations lower than those reported for mammals. The results are discussed with reference to recent views on thyroid action in mammals; the data from trout mitochondria support and confirm the mammalian work. (Authors)

11107. Ergens, R. (Inst. Parasitol., Czech. Acad. Sci., Prague, Czech.). 1966. REVISION OF THE HELMINTHOFAUNA OF FISHES FROM CZECHOSLOVAKIA: IV. GROUP OF THE SPECIES Gyrodactylus elegans Nordmann, 1832 (MONOGENOIDEA). Folia. Parasitol., 13(3): 212-221. Illus.; Biological Abstracts, 49(20): Abst. No. 107935. 1968.

New determining criteria, revealed by the use of modern microscopic techniques, led to a revision of the morphological group represented by the species Gyrodactylus (Gyrodactylus) elegans Nordmann, 1832. The present paper contains detailed descriptions and drawings of the six species under this morphological group: G. (G.) elegans, G. (G.) prostae Ergens, 1963 (previously found in Czechoslovakia), G. (G.) laevis Malmberg, 1956, G. (G.) minimus Malberg, 1956 (new to the fauna of Czechoslovakia), G. (G.) paralaevis and G. (G.) paraminimus. (Auth.)

11108. Tagatz, Marlin E. (Bur. Commercial Fisheries Biological Lab., Beaufort, N. C.). 1967. FISHES OF THE ST. JOHNS RIVER, FLORIDA. Quart J. Fla. Acad. Sci., 30(1): 25-50. Map; Biological Abstracts, 49(20): Abst. No. 108280. 1968.

Collections obtained from the St. Johns River (April 1961 to November 1963) contained 51 spp. of fish not previously recorded for the river. These records are included in a checklist of all St. Johns fishes—170 spp. representing 55 families. For each of the 101 euryhaline forms collected in this study, the number and length range of fish, by month, and salinity and temperature data are presented. (Auth.)

11109. Isaev, A. I. 1967. FISH PASSAGEWAYS IN THE SOVIET UNION. (O rabote ryboprupusknykh sooruzhenii v Sovetskom Soyuze). In: Fish behavior in the vicinity of hydraulic structures. Nauka: Moscow. 43-50. From: Ref. Zh., Biol., 1968, No. 11119. (Translation); Biological Abstracts, 49(21): Abst. No. 108929. 1968.

Ten fish passageways were built in the USSR, and plans were drawn up for the building and reconstruction of passageways in other hydroelectric schemes. Of the passageways currently in use, the most effective ones are the Volgograd and Tsimlyansk fishlifts and the Tuloma, Kolvitsa and Keguma fishways. The Volgograd fishlift was built for the escapement of sturgeon, beluga, sevriuga and shad. In the period from 1961 to 1964 there were 2,500,000 escapees. The duration of a cycle is 3 hours. The current speed in the lower raceways, which play an important role in attracting fish, is 0.7-0.8 m/sec. Despite the excellent work of the Volgograd fishlift, it does not permit the escapement of a sufficient number of spawners. For this reason, some spawners are transported through channels. Because the Tsimlyansk fishway is structurally defective, sturgeons have difficulty in traversing it. Plans are under way for its reconstruction. Of the fishways now in use, the most effective is the Tuloma fishway. As many as 4,000-11,000 Atlantic salmon spawners traverse it annually. In the period 1945-1956 a total of 324,570 spawners passed through it. To ensure the effectiveness of fish passageways, it is necessary to know the number of adult fish going upstream and the number of young fish going downstream.

11110. Hendrickson, Wayne A., Warner E. Love, and George C. Murray (The Johns Hopkins Univ., Baltimore, Md.). 1968. CRYSTAL FORMS OF LAMPREY HEMOGLOBIN AND CRYSTALLINE TRANSITIONS BETWEEN LIGAND STATES. J. Mol. Biol., 33(3): 829-842. Illus.; Biological Abstracts, 49(21): Abst. No. 109591. 1968.

Hemoglobin from the sea lamprey, Petromyzon marinus, was crystallized in nine basic forms having polymeric asymmetric units containing 1, 6, 8, 10, 12 or 16 monomers. This polymorphism and further variations within some of the forms are particularly dependent on temperature, salt of crystallization and ligand state of the heme iron. Additional variations in a form result when the ligand state is changed within the crystal. All the crystal types so far acquired, whether by growth or by intracrystalline transition, have been catalogued. Crystalline transitions between ligand states tend to fall into two classes. In the first case, both the crystal lattice and the intensity distribution change only a little. The transition product is essentially isomorphous with its parent. In the second case, the lattice parameters change by as much as 10% and the diffracted intensity is distributed quite differently. Changes of the ligand state in the monomeric form of lamprey hemoglobin are always accomplished isomorphously; only the polymeric forms can undergo non-isomorphous transitions. Changes of ligand state are thought to effect in some subtle way the modification of potential polymerization sites on the monomer without appreciable alteration of the protein conformation. In crystals with monomeric asymetric units such changes would have little effect on the diffraction pattern. However, if the affected sites were actual points of contact between the subunits of polymeric crystals then, within the constraints imposed by lattice forces, a re-arrangement of the subunits with attendant changes in the diffraction pattern could ensue. (Authors)

11111. Mounib, M. S., and J. S. Eisan (Fish. Res. Board of Canada, Halifax Lab., Halifax, N. S., Canada). 1968. BIOSYNTHESIS OF LIPIDS BY SALMON SPERM FROM PYRUVATE, ACETATE AND GLYOXYLATE. Comp. Biochem. Physiol., 25(1): 193-200; Biological Abstracts, 49(21): Abst. No. 109771. 1968.

When salmon sperm were incubated with C^{14}-pyruvate, -acetate, or -glyoxylate labeled in different positions, any carbon atom in any position of these substrates could go into lipids, and the incroporation was highest with glyoxylate, less with pyruvate and least with acetate. Incorporation into fatty acids and the non-saponifiable fraction followed the same order, although these two fractions comprised a relatively small part of the total lipid extract. Only label from glyoxylate was detectable in cholesterol. Malonate enhanced the biosynthesis of lipids by sperm from all substrates studied. Succinate depressed the incorporation of pyruvate and acetate into lipids by sperm, whereas it promoted incorporation of labeled carbon from glyoxylate into lipids. (Authors)

11112. Terner, Charles (Biol. Sci. Cent., Boston Univ., Boston, Mass.). 1968. STUDIES OF METABOLISM IN EMBRYONIC DEVELOPMENT: III. GLYCOGENOLYSIS AND GLUCONEOGENESIS IN TROUT EMBRYOS. Comp. Biochem. Physiol., 25(3): 989-1003; Biological Abstracts, 49(21): Abst. No. 111597. 1968.

Control mechanisms permitting the accumulation of free glucose in developing trout embryos were studied. In cell-free extracts, free glucose increased following the rapid destruction of ATP. When the ATP level was maintained, glucose declined with appearance of lactate. The breakdown of glycogen was shown to be the main source of free glucose. Gluconeogenesis from pyruvate-2-C^{14} and glycerol-1, 3-C^{14} was also demonstrated in intact embryos and in cell-free extracts. The level of ATP in the embryo appears to control the maintenance of a pool of free glucose, too small to support the endogenous respiration, but adequate for brief outbursts of activity. (Auth.)

11113. Sheri, A. N., and G. Power (Dept. of Biology, Univ. of Waterloo, Waterloo, Ont., Canada). 1969. VERTICAL DISTRIBUTION OF WHITE PERCH, Roccus americanus, MODIFIED BY LIGHT. Can. Field Nat., 83(2): 160-161.

11114. Martin, Richard (Dept. Zool., Ohio State Univ., Columbus, Ohio). 1968. THE EFFECT OF MALACHITE-GREEN AS A FUNGICIDE. Ohio J. Sci., 118-121; Biological Abstracts, 49(21): Abst. No. 112551. 1968.

A series of tests with malachite green, used at various concentrations and treatment durations, were made on six species of watermolds known to be parasitic on fish and/or fish eggs. These species have markedly different tolerances to the dye. While a treatment of as little as 1 ppm of malachite green for 5 minutes was effective for Saprolegnia parasitica, it took 10 ppm for 5 minutes to control Achlya ambisexualis and Allomyces macrogynus, and 15 ppm for 1 hour to control Achlya oblongata. (Auth.)

11115. Bocharov, G. D. 1966. CHEMICAL ANALYSIS OF PINK SALMON (Oncorhynchus gorbuscha) HELD IN GRADIENTS OF SALINITY AND TEMPERATURE. (Khimicheskii analiz u gorbushi (Oncorhynchus gorbuscha Wald.) v gradientnykh usloviyakh solenosti i temperatury). Tr. Murmansk Morsk Biol. Inst., 12.16. 65-75. From: Ref. Zh., Biol., 1967, No. 4I153. (Translation); Biological Abstracts, 49(22): Abst. No. 114619. 1968.

The distribution of fingerling, yearling and 2-summer pink salmon in aquaria having gradients of salinity and temperature was studied. After preliminary adaptation to sea water of different salinities, all three groups prefer sea water. Fingerlings adapted to fresh water prefer sea water. A difference in the temperature of fresh and sea water exerts an influence on the selective reaction of salt water. Variations on O_2 concentration did not appreciably affect the selective reaction, but it was found to depend on the illumination of the aquarium. Thus yearlings of one group occurred more frequently in sea water during daytime hours, and in fresh water during evening hours. A characteristic feature of the behavior of pink salmon in gradient conditions is the testing of the water of a particular layer on approaching the boundary of the layer.

11116. Diarova, G. S. 1966. MAJOR DISEASES OF POND FISHES AND THEIR CONTROL IN SOUTHERN KAZAKHSTAN. (Osnovnye bolezni prudovykh ryb i bor'ba s nimi v usloviyakh yuga Kazakhstana). In: Fish diseases and methods of their control. Nauka: Alma-Ata. 81-87. From: Ref. Zh., Biol., 1967, No. 9I197. (Translation); Biological Abstracts, 49(22): Abst. No. 114620. 1968.

At five fish farms of Kazakhstan a parasitological study was made of carp, tench, crucian carp, marinka and coarse fishes. In 14 species of fish were found 37 species of parasites. Of these, 15 were observed in carp. Among the diseases were recorded ichthyophthiriasis (most widespread), trichodiniasis, dactylogyrosis, gyrodactylosis, sanguinocoliasis, botriocephalosis, caviosis, argulosis, pox, gill-rot, dermatomycosis and red-spot disease. Methods for controlling fish diseases are described.

11117. Privol'nev, T. I. 1966. RESPONSE OF YOUNG ATLANTIC SALMON TO VARIOUS WATER SALINITIES. (Otnoshenie molodi semgi k razlichnoi solenosti vody). Tr. Murmansk Morsk Biol. Inst., 12.16. 54-64. From: Ref. Zh., Biol., 1967, No. 4I152. (Translation); Biological Abstracts, 49(22): Abst. No. 114664. 1968.

Fingerling and yearling Atlantic salmon of various sizes were placed in salt solutions (concentration 10, 15, 20 and 25%) for up to 15 days. Larvae in which half of the yolk sac had been absorbed were placed in water of 5, 7 and 10 ‰ salinity. The salt tolerance of young Atlantic salmon increased with development and growth. The limiting salinity for larvae was 7 ‰, for fingerlings 10-15 ‰, for yearlings 15-20 ‰. The blood delta of yearlings and smolts changed very little; a salinity greater than 20 ‰ caused a substantial increase in the blood delta. The rate of penetration of salts from the surrounding medium into the blood was higher in yearling Atlantic salmon than in perch. Young Atlantic salmon lose salts when placed in water of high salt content. Young transferred from fresh water to an aquarium with a salinity gradient ranging from 0 to 20 ‰, preferred fresh water; after a 48-hour adaptation to water of 15 ‰ salinity, they showed a greater preference for salt water than for fresh. Depending on their physiological condition, young of weight 6-10 g can survive a salinity of 15-20 ‰ and may, if necessary, be released from the hatchery into the pro-estuarine region of the sea, not into the river.

11118. Scott, Mary (Northumbrian River Auth., Newcastle, England). 1968. THE PATHOGENICITY OF Aeromonas salmonicida (Griffin) IN SEA AND BRACKISH WATERS. J. Gen. Microbiol., 50(1/2/3): 321-327; Biological Abstracts, 49(22): Abst. No. 114669. 1968.

The experimental pathogenesis of A. salmonicida for the sea trout (Salmo trutta) and the brown trout (S. fario) in sea and brackish waters was examined by contact between infected and healthy fishes. Sea trout and brown trout both acquired infection by contact with infected S. fario at salinity values from 2.54% to 3.31% (w/w) when water temperatures ranged from 5.6° to 14.5°. The species differed in their resistance to infection. About 90% of the sea trout became infected and died within 7 days, developing superficial lesions typical of the disease. The brown trout appeared to be more resistant, about 75% developing and dying from andatypical form of the disease.

11119. Wedemayer, Gary (Bur. of Sport Fisheries and Wildlife, Western Fish Disease Lab., Seattle, Wash.). 1968. UPTAKE AND DISTRIBUTION OF Zn^{65} IN THE COHO SALMON EGG (Oncorhynchus kisutch). Comp. Biochem. Physiol., 26(1): 271-279. Illus.; Biological Abstracts, 49(22): Abst. No. 114691. 1968.

Zinc uptake and distribution in the developing coho salmon egg was measured using radioisotope tracer techniques. The uptake was affected by pH, temperature, Cu^{2+}, 2,4-fluorodinitrobenzene and the azo dye malachite green; but not by azide ion or 2,4-dinitrophenol. About 70% of the total accumulated Zn was bound, rather firmly, to the chorion; about 26% was found in the perivitelline fluid, about 2% in the yolk, and about 1% in the embryo. Temperature, pH, inhibitor and kinetic studies indicated that Zn uptake involves physico-chemical sorption to the chorion together with passive diffusion into the yolk and embryo. (Auth.)

11120. Kudinskii, O. Yu. 1966. MICROSCOPIC ANATOMY OF THE DIGESTIVE TRACT OF ATLANTIC SALMON (Salmo salar) FINGERLINGS. (Mikroskopicheskaya anatomiya pishchevaritel'nogo trakta mal'kov semgi (Salmo salar) fingerlings). Tr. Murmansk Morsk Biol. Inst., 12.16. 112-119. From: Ref. Zh., Biol., 1967, No. 4I20. (Translation); Biological Abstracts, 49(22): Abst. No. 115158. 1968.

Observations on the microscopic structure of the digestive organs were carried out during a 50-day period following absorption of the yolk sac. With increase in fingerling size, the boundary between the esophagus and stomach becomes more distinct; the difference between the diameters of the cardiac and pyloric parts of the stomach increases, as does the number of pyloric ceca (28 in 10-day-olds, and 52 in 50-day-olds); the number of intestinal transverse folds decreases (from more than 70 at 10 days to 35 at 50 days). The swim bladder of 10- to 15-day-olds is not distended. The fingerlings usually occur on the bottom. With increasing age their activity increases, 40-day fingerlings swimming easily in all directions but rarely descending to the bottom (for protection against bright sunlight); their swim bladders are distended and function normally. At 10-12 days they exhibit a rudimentary spiral valve, which disappears in older age groups.

11121. Graham, Charles R., Jr., and Henry F. Edelhauser (Loyola Coll., Baltimore, Md.). 1968. WATER AND ION MOVEMENT ACROSS THE GAS BLADDER OF TWO PHYSOSTOMOUS FRESH-WATER TELEOSTS. Comp. Biochem. Physiol., 25(3): 937-942; Biological Abstracts, 49(22): Abst. No. 115513. 1968.

Evidence for processes which can control the movement of tissue fluid across the trout gas bladder is presented. Trout gas bladders have a low permeability to water and measurable potentials exist across these structures (3.09 mV in the brook trout and 1.33 mV in the rainbow trout). Potentials are not due to Na^+ transport but may be, in part, due to Cl^- transport. (Authors)

11122. Mackay, W.C., and D.D. Beatty (Dept. Biol., Case West. Reserve Univ., Cleveland, Ohio). 1968. THE EFFECT OF TEMPERATURE ON RENAL FUNCTION IN THE WHITE SUCKER FISH, Catastomus commersonii. Comp. Biochem. Physiol., 26(1): 235-245. Illus.; Biological Abstracts, 49(22): Abst. No. 115517. 1968.

The effect of temperature on urine flow, renal tubular water reabsorption and renal glucose reabsorption was investigated in the white sucker. Urine flow increased

with increasing temperature over the range 2-18° C (Q_{10}=2.2). Temperature did not significantly affect the proportion of filtered water which was reabsorbed and had only a slight effect on the proportion of filtered glucose reabsorbed (Q_{10}=1.21). Intermittent glomerular function appears to be the means by which the rate of urine flow is controlled in the white sucker. (Authors)

11123. Gras, J., R. Reynaud, L. Gamoty, J. Frey, and J.C. Henry (Fac. Med. Pharm., Lyon, France). 1967. BIOCHEMICAL STUDY OF FISH: SEMI-ANNUAL VARIATIONS IN MINERAL, TOTAL LIPID, AND GLYCOGEN CONTENT IN THE RAINBOW TROUT (Salmo gairdnerii Rich). (Etude biochimique des poissons: 2. Variations semestrielles de la teneur en glycogene, en lipides totaux et en mineraux du tissu musculaire de la truite Arc-enciel (Salmo gairdnerii Rich.). Experientia, 23(6): 431-432. (Engl. summ.); Biological Abstracts, 49(22): Abst. No. 115651. 1968.

During the reproductive cycle of the rainbow trout (S. gairdnerii Rich.), important variations concerning water and total proteins content were noted. This study shows a great correlation between the biological process and biochemical variations. (Authors)

11124. Yamamoto, M. (Fish. Res. Board of Canada, Vancouver, B.C., Canada). 1968. FISH MUSCLE GLYCOGEN PHOSPHORYLASE. Can. J. Biochem., 46(5): 423-432. Illus.; Biological Abstracts, 49(22): Abst. No. 116106. 1968.

Glycogen phosphorylase.b was purified 70- to 90-fold from skeletal muscle of rainbow trout (Salmo gairdneri). The purified enzyme exhibited maximal activity near pH 6.8 at 37°. Of several 51-nucleotides tested, only 5'-AMP caused stimulation of phosphorylase b. The K_m value for glucose-1-phosphate was 10-15 mM, and for 5'-AMP, 0.2-0.4 mM. Glucose (25 mM) had no effect. Inactive trout muscle phosphorylase was converted to the active form in vivo by subjecting a fish to physical exercise. The conversion of fish muscle phosphorylase b to a was also catalyzed in vitro with purified rabbit muscle phosphorylase b kinase in the presence of ATP and Mg^{++}. Evidence is presented to indicate the presence of phosphorylase b kinase and phosphorylase phosphatase in trout skeletal muscle. (Auth.)

11125. Hansen, Edward A. (Lake States N. Cent. Forest. Exp. Sta., St. Paul, Minn.). 1968. STABILIZING ERODING STREAMBANKS IN SAND DRIFT AREAS OF THE LAKE STATES. U.S. Forest Serv. Res. Pap. N. C. 21. 1-12. Illus., Map; Biological Abstracts, 49(23): Abst. No. 119194. 1968.

Banks are stabilized to protect adjacent high-value items such as cabins and campgrounds, or to reduce reservoir or lake sedimentation rates. Also, bank stabilization is undertaken as one part of fish habitat improvement programs. Rock rip-rap is the best material for bank stabilization in most cases. It does not deteriorate with time and it blends in well with the surroundings. The upper part of the bank will revegetate naturally. However, sloping and seeding will accelerate revegetation. (Auth.)

11126. Berdyshev, G.D., G.K. Korotaev, G.V. Boyarskikh, and B.F. Vanyushin. 1967. INVESTIGATION OF DNA NUCLEOTIDE COMPOSITION IN SOMATIC TISSUES OF SPAWNING HUMPBACK SALMON. (Issledovanie nukleotidnogo sostava DNK v somaticheskikh tkanyakh nerestuyushchei gorbushi). Tsitol. Gnet., 1(3): 56-60. (Engl. summ.); Biological Abstracts, 49(23): Abst. No. 119487. 1968.

The nucleotide composition of DNA in somatic tissues of humpback salmon was studied by paper chromatography. The ingredient content was as follows: adenine and thymidine at an average of 28, guanine at 22, cytosine at 20, 5-methylcytosine at 1.8-2.1 molar percent. The 5-methylcytosine content in DNA of the fish somatic tissues was reduced by 35-40% with the advance of spawning migration. Experimental data are discussed in connection with study of the genetic mechanisms involving cell death in spawning humpback salmon. (Authors)

11127. Latta, William C. (Inst. Fish. Res., Mich. Dept. Conserv., Ann Arbor, Mich.). 1968. THE LIFE HISTORY OF THE SMALLMOUTH BASS, Micropterus d. dolomieui, AT WAUGOSHANCE POINT, LAKE MICHIGAN. Mich. Dept. Conserv. Inst. Fish. Res. Bull., 5. 9-56. Illus., Map; Biological Abstracts, 49(23): Abst. No. 119990. 1968.

11128. Letovaltseva, V.I. 1967. ATLANTIC SALMON TAGGING EXPERIMENTS ON THE PECHORA IN 1960-64. (Rezul'taty mecheniya semgi na Pechore v 1960-64 gg). Izv. Komi. Filiala Vses. Geogr. Obshchest., 2(1): 142-146. From: Ref. Zh., Biol., 1968, No. 2I10 (Translation); Biological Abstracts, 49(23): Abst. No. 119992. 1968.

In 1960-64, a total of 4, 140 specimens of mature Atlantic salmon, mostly 5+ years of age, were tagged near the villages of Yushchino and Mesino, in order to investigate their migrations. A heavy run was observed between the end of July and the end of August. In the spawning tributaries of the Pechora, tagged fish were recaptured a year after tagging. In the course of a 24-hour period, the heaviest run occurred at 4-8 hours in the morning and the lighest run at 16-20 hours. From the river's mouth to Mesino, the Atlantic salmon moved mainly along the streambed; higher upstream they moved along the Lesser Pechora. The migration speed was 9-18 km/day in the delta and 47 km/day upstream, decreasing as the temperature decreased. The Pechora Atlantic salmon migrates to the Norwegian Sea at an average speed of 30 km/day.

11129. Van Derwalker, John G. (Bur. of Commercial Fisheries, Fish-Passage Res. Program, Seattle, Wash.). 1967. RESPONSE OF SALMONIDS TO LOW FREQUENCY SOUND. In: Marine bio-acoustics. Vol. 2. Proc. 2nd Symp., 13-15 April 1966. New York. Pergamon Press: London, New York and Sydney, Aust. Mar. Bio-Acoustics, 2. 45-58. Illus.; Biological Abstracts, 49(23): Abst. No. 120013. 1968.

The construction of dams in the Columbia River system for the production by hydroelectric power has created numerous problems for anadromous fish. Some of the difficulties relate to the loss of juveniles migrating downstream, which are unable to find their way through reservoirs or are injured as they pass through turbines or over spillways. In an effort to prevent this loss, the Bureau of Commercial Fisheries was studying various methods of guiding these fish into collection facilities for passage around hazardous areas. This paper reviews past and current research on the use of sound as a method of guiding downstream migrating salmonids. (From auth.)

11130. Tarr, H. L. A., Joan E. Roy, and M. Yamamoto (Fish. Res. Board of Canada, Vancouver, B. C., Canada). 1968. FISH LIVER PYRIMIDINE DEOXYNUCLEOSIDE PHOSPHORYLASE AND DEOXYRIBOSYLTRANSFERASE. Can. J. Biochem., 46(5): 407-415. Illus.; Biological Abstracts, 49(23): Abst. No. 120213. 1968.

A pyrimidine deoxynucleoside phosphorylase, which also possessed deoxyribosyltransferase activity, was purified about 89-fold from trout liver with an average recovery of 67%. Starch-gel electrophoresis showed that four proteins were present, one of which possessed both activities. The phosphorylase utilized uracil, thymine, and 5-halogen-substituted uracils, but not cytosine, adenine, or hypoxanthine in presence of deoxyribose 1-phosphate. Deoxyuridine, thymidine, and the deoxynucleosides of the 5-halogen-substituted uracils, but not uridine, deoxycytidine, deoxyadenosine, deoxyinosine, or deoxyguanosine, were substrates for the reverse reaction. The enzyme possessed a much higher affinity for deoxyuridine than for thymidine, the K_m values being 1.7×10^{-3} M and 1×10^{-2} M respectively. The optimum pH was 6.2. The enzyme was destroyed by freezing, rapidly inactivated at 45° and by dialysis. It was very unstable in absence of 2-mercaptoethanol and fairly unstable in absence of orthophosphate. Deoxyuridine phosphorolysis was inhibited noncompetitively by thymine and uracil. The transferase exhibited no sharp pH optimum and utilized the same substrates as did the phosphorylase. The ratio transferase/phosphorylase remained approximately constant (4.0) during

purification. The enzyme formed 3-deoxyribosylxanthine in small amounts from xanthine plus deoxyribose 1-phosphate and from deoxyuridine plus xanthine. (Authors)

11131. Pavlovic, Vojislav (Abteil. Physiol., Biol. Inst., Univ., Sarajevo, Yugoslavia). 1968. SEASONAL VARIATIONS OF THE BLOOD-SUGAR LEVEL AND OF LIVER GLYCOGEN IN Thymallus thymallus L. AND Salmo trutta m. fario L. AT NEARLY CONSTANT WATER TEMPERATURE. (Die jahreszeitlichen Schwankungen des Blutzuker-Spiegels und des Leberglycogens von Thymallus thymallus L. und Salmo trutta m fario L. bei nahezu konstanter Temperatur des Wassers). Z. Vergl. Physiol., 59(1): 72-77. Illus.; Biological Abstracts, 49(23): Abst. No. 120300. 1968.

Even at constant temperature the concentrations of glucose (GLU) in the blood and of glycogen (GLY) in the liver of Thymallus thymallus and Salmo trutta m. fario were dependent on the seasons of the year. During the summer months both the concentration of GLU in blood and the contents of GLY in liver decrease. Furthermore the concentration of GLU in blood and GLY in liver are notably higher in T. thymallus. (Auth.)

11132. Moulton, James M., and Richard H. Dixon (Bowdoin Coll., Brunswick, Me.). 1967. DIRECTIONAL HEARING IN FISHES. In: Marine bio-acoustics. Vol. 2. Proc. 2nd Symp. 13-15 April 1966. New York. Pergamon Press: London, New York, and Sydney, Aust. Mar. Bio-Acoustics 2. 187-232. Illus.; Biological Abstracts, 49(23): Abst. No. 121406. 1968.

The variations in the acoustical detecting mechanisms of fishes are reviewed, and, in particular, the mechanisms by means of which directional hearing may take place. Directional hearing may occur only at close range to the sound source, i.e., in the near field. The Mauthner's cells present in many fishes and amphibians are motor neurons that are associated with rapid escape reflexes. They receive impulses directly from certain sense organs, including acoustical neurons. There may exist in fishes a mechanism for directional orientation to sound which does not necessarily require a completely isolated pair of ears. The well-known Mauthner cell mechanism, long recognized as a mechanism providing for rapid response to visual and auditory stimuli, may be sufficient to account for directional orientation to underwater sound received through the ears. In the present experiments where only the parts of the auditory nerve probably most concerned with hearing in the goldfish and probably containing the fibers which run to the Mauthner's cells were cut, it seems likely that a directional response occurring on auditory stimulus was eliminated or reversed by appropriate operations and training. None of the results is inconsistent with the probability that the Mauthner cell mechanism does play a role in directional responses by fishes to underwater sound perceived through the ears. The unusually rapid rates of transmission and of collateral inhibition over the Mauthner cell pathway are suggestive that directional orientation is an extremely early event in the tail-flip response of fishes to auditory stimuli. Whether or not this orientation is reflected in subsequent behavior may depend on circumstances. (Authors)

11133. Disler, N.N. 1967. DEVELOPMENT OF PIKE (Esox lucius) LATERAL-LINE SENSE ORGANS. (Razvitie organov chuvstv sistemy bokovoi linii shchuki--Esox lucius (L.)). In: Morpho-ecological studies of fish development. Nauka: Moscow. 148-162. From: Ref. Zh., Biol., 1967, No. 10125. (Translation); Biological Abstracts, 49(23): Abst. No. 122837. 1968.

In contrast to many cyprinoid and percoid fishes, pike young pass through three embryonal stages within the egg shell. Endogenic feeding continues in the third stage, during which the embryo's mobility increases, the sense organs undergo rapid differentiation, and sensitivity to current direction, as well as to tactile stimuli, arises. With transition to the larval period of development, endogenic feeding becomes replaced by external feeding, the larvae start moving in search of food and rearrangement of sensory organs commences. The eyes during this period become mobile, and binocular vision appears. The differentiation of primary

neuromasts is completed. The lateral-line organs during the early development stages are not used in hunting for food: they are adapted mainly to preception of signals warning of approach to danger. Regeneration of secondary neuromasts on the body surfaces of larvae is associated with the developmental conditions in the coastal zone. During the larval period the neuromasts remain exposed. With transition to the fingerling stage, part of neuromasts located on the head become modified to sensory canal buds; those that remain exposed become embedded in the epidermis and change into pit organs. The fish start to frequent weeds under conditions of lower illumination; their eyes become smaller, and larvae of other fishes acquire greater importance in the diet. Numerous secondary neuromasts arise on body and tail, but, in contrast to other fishes, they are distributed not transversely but longitudinally with respect to the body axis. This work and the observations of physiologists refute the notion about the reduction of the lateral-line sense organs of pike.

11134. Chen, F. Y., and G. A. Prowse (Trop. Fish Cult. Res. Inst., Malacca, Fed. Malaysia). 1964. THE EFFECT OF LIVING SPACE ON THE GROWTH RATE OF FISH. Ichthyologica, 3(1/2): 11-20. Illus.; Biological Abstracts, 49(24): Abst. No. 125378. 1968.

The effect of living space or surface area of free movement of the growth rate of fish was studied. In ponds divided unequally by wire mesh and stocked at a uniform rate per area the fish grew larger in the larger area. In ponds ranging from 0.01 to 1 acre which were stocked with all-male hybrid Tilapia mossambica the fish grew largest in the largest ponds. There was little difference between the smallest ponds. The reasons for the living space effect are discussed and a theory based on social hierarchy is proposed. (Authors)

11135. Legendre, V. (Min. Chasse, Peche, Prov. Que., Quebec City, Canada). 1967. THE FRESHWATER SALMON FROM QUEBEC: THE SPORTING FISH OF THE FUTURE. Que. Serv. Faune Bull., 11. 3-40; Biological Abstracts, 49(24): Abst. No. 125414. 1968.

Some aspects of the history of the freshwater salmon S. salar are reviewed. Its relationship with the Atlantic salmon are indicated and their management discussed. Coloration, the form of the caudal peduncle, renal function and the survival possibilities of eggs and of young fish are described. There is no difference in the number of vertebrae between the freshwater and the marine salmon. The freshwater salmon originate in a lake north of the Nabisipi River, in lake Saint-Jean, in lake Sorcier in Maskinonge County and in an eastern pisciculture station. The requirements of freshwater salmon, its spawning, water temperature and quantity necessary for spawning, choice of nesting place and material and its outlook for the future, management and conservation measures are discussed. -- R. Kroha.

11136. Miles, Harry M., and Lynwood S. Smith (Fish. Res. Inst., Univ. Wash., Seattle, Wash.). 1968. IONIC REGULATION IN MIGRATING JUVENILE COHO SALMON, Oncorhynchus kisutch. Comp. Biochem. Physiol., 26(2): 381-398. Illus.; Biological Abstracts, 49(24): Abst. No. 125424. 1968.

The mean levels for hematocrit (37.8%) percentage of total dissolved solids (4.77%), and Na (146.7 mequiv. /liter), K (8.58 mequiv. /liter) Ca (6.73 mequiv. / liter), Mg (1.08 mequiv. /liter) and chloride (177.3 meq/liter) concentrations in blood plasma were determined for juvenile coho salmon in fresh water. Observations suggest a correlation between hematocrit and temperature during the winter and spring residence in fresh water. No premigratory change in electrolyte composition was observed. Migrating juvenile coho salmon were transferred into sea water to observe changes in blood parameters during the adjustive phase. The adjustive phase was apparently completed in about 36 hours and was characterized by transient increases in plasma concentrations of Na, chloride and Mg. (Authors)

11137. Frank, Thomas H. (Dept. Elec. Eng., New York Univ., Bronx, N. Y.). 1968. TELEMETERING THE ELECTROCARDICGRAM OF FREE SWIMMING Salmo irideus. IEEE Trans. Bio-Med. Eng., 15(2): 111-114. Illus.; Biological Abstracts, 49(24): Abst. No. 125893. 1968.

An FM (frequency modulation) telemetering system capable of being carried on the back of a free swimming fish is described. The transmitter can be turned on and off with a hand-held magnet and has a useful life of more than 135 hours of continuous operation. The ecg from the rainbow trout was telemetered from an aquarium to a nearby laboratory table. The effects of MS-222 (ethyl-m-amino benzoate) and Urethane on heart rate are discussed; and problems encountered in the placement of the ecg leads are also discussed. Artifacts due to opercular movements and effects of MS-222 and Urethane are interpreted. (Auth.)

11138. Meyer, Marvin C., and Rolf Vik (Zool. Mus., Univ. Oslo, Oslo, Norway). 1968. OBSERVATIONS ON Diphyllobothrium sebago PLEROCERCOIDS IN THE FISH HOSTS. Proc. Helminthol. Soc. Wash., 35(1): 92-96. Illus.; Biological Abstracts, 49(24): Abst. No. 129627. 1968.

In an examination of 4, 693 freshwater fishes, comprising 94 landlocked salmon, Salmo salar; 3 brook trout, Salvelinus fontinalis; 4, 500 landlocked American smelt, Osmerus mordax; and 96 yellow perch, Perca flavescens, for plerocercoids of Diphyllobothrium sebago, only the salmon, trout, and smelt were found infected. In the salmon, ranging from 27 cm through 69 cm and II+ through VII+ years, the incidence of infection and the mean intensity of infection increased with host size. A 59 cm, VII+ salmon harbored 312 larvae; 309 in the viscera and three in the flesh. Among the 4, 500 smelt, 209 plerocercoids were recovered. (Authors)

11139. Blaxter, J. H. S. 1969. EXPERIMENTAL REARING OF PILCHARD LARVAE, Sardina pilchardus. J. mar. biol. Ass. U. K., 49(3): 557-575.

After initial trials a technique was devised which made it possible to rear about 12% of newly hatched larvae of the pilchard Sardina pilchardus (Walbaum) to a point well beyond the yolk-sac stage. A survival rate of this order was considered quite satisfactory for larvae which are so small at hatching. Circular 25-liter tanks of black plastic provided with annular lighting of intensity about 500 m. c. were used and natural live plankton from offshore, suitably processed, provided as food. The sea water was initially obtained from offshore and partially replaced daily. Antibiotics were used in the egg stage. Some larvae survived at least 10 months, reaching a maximum length of 52 mm. It is considered that transfer to larger tanks at a length of 15-20 mm would have reduced the slow mortality subsequent to the main experiments. (Auth.)

11140. Foxton, P. (National Inst. of Oceanography, Wormley, Surrey, U. K.). 1969. SOND CRUISE 1965. BIOLOGICAL SAMPLING METHODS AND PROCEDURES. U. mar. biol. Ass. U. K., 49(3): 603-620.

Details are given of the nets used and the sampling procedures adopted to investigate patterns of vertical distribution in an oceanic pelagic fauna. Ancillary gear and laboratory methods are described. The paper concludes with a discussion of the limitations of the sampling. (Auth.)

11141. Khalil, L. F. 1969. LARVAL NEMATODES IN THE HERRING (Clupea harengus) FROM BRITISH COASTAL WATERS AND ADJACENT TERRITORIES. J. mar. biol. Ass. U. K., 49(3): 641-659.

Investigations on larval nematodes in herring revealed that Anisakis sp. larvae occurred in the body cavity of 34% of 5, 646 juvenile and adult herring examined; and that the infection increased with increase in fish length (age) and varied with the locality, being greater in herring caught nearer to the British coasts. The effect of temperature and salt concentrations on the survival of the larvae and the public health hazards of the larvae were discussed. Fifteen percent of 3, 320 juvenile herring examined were found infected with larvae of Contracaecum aduncum (Rudolphi, 1802) in the body cavity but this infection decreased with increase in fish length (age), probably due to the development of resistance with ageing. The infestation was compared with that of sprat. (Auth.)

11142. Kennedy, M., and P. Fitzmaurice. 1969. AGE AND GROWTH OF THICK-LIPPED GREY MULLET Crenimugil labrosus IN IRISH WATERS. J. mar. biol. Ass. U.K., 49(3): 683-699.

The authors examined more than 900 thick-lipped grey mullet, Crenimugil labrosus (Risso), from 23 different localities on the Irish coast. The fish ranged in size from fry 1.5-2.0 cm long to adults of up to 58.5 cm long. The scales of mullet show annuli but, with growth, the innermost annuli on the scales become obscured. The otoliths can, however, be used to age mullet up to 5 years old. By combining scale reading with examination of otoliths it was possible to work out length-for-age estimates for mullet up to 5 years old. The growth of older mullet, up to 17 years old, was back-calculated from their scales. The number of annuli "lost" from the scales was estimated by reference to the data for young fish—the ages corresponding to the innermost annuli being judged according to the calculated fork-lengths represented by such annuli and according to whether the fish was growing rapidly or slowly. The mean length-for-age values determined for all the mullet examined lay along a curve. In terms of length, the growth of males and females was similar, though females tended to be somewhat heavier for their length. Thick-lipped grey mullet in Irish waters were found to be slow-growing, longlived and probably late-maturing fish. (Authors)

11143. Rees, Gwendolen (Dept. of Zoology, Univ. College of Wales, Aberystwyth, U.K.). 1969. CESTODES FROM BERMUDA FISHES AND AN ACCOUNT OF Acompsocephalum tortum (Linton, 1905) GEN. NOV. FROM THE LIZARD FISH Synodus intermedius (Agassiz). Parasitology, 59(3): 519-548.

Of 414 Bermuda fishes belonging to 58 species 69 belonging to 20 species were infested with adult or larval cestodes. Five species of adult and five species of larval cestodes were recovered. There are 18 new host records and seven new records for Bermuda. Four of the adult cestodes were found in the cub shark Carcharinus platyodon (Poey). Larval cestodes were found in 66 individuals of 18 species of fishes mainly groupers and rock fishes from the outer reefs and deep water where sharks abound. It is suggested that the restriction of cestodes of Bermuda fishes is due to the isolation of the fishes into the deep water population of the outer reefs and beyond and the shallow water population of the inner reefs. Acompsocephalum tortum (Linton) was the only cestode from a teleost Synodus intermedius (Agassiz). It has been included in a new family in the Pseudophyllides but has affinities, also, with the Spathebothridea. It is described and its significance relative to the evolution of the strobilate cestodes is discussed. (Auth. summ.)

11144. Schoettger, Richard A., and Arnold M. Julin (Fish Control Lab., Bur. of Sport Fisheries and Wildlife, La Crosse, Wis.). 1969. INVESTIGATIONS IN FISH CONTROL. 22. EFFICACY OF QUINALDINE AS AN ANESTHETIC FOR SEVEN SPECIES OF FISH. Bureau of Sport Fisheries and Wildlife Investigations in Fish Control 22. 10 p.

Quinaldine was tested as an anesthetic for rainbow trout, brown trout, brook trout, lake trout, channel catfish, bluegill, and largemouth bass. In general, 15 to 70 ppm of the drug induce total loss of equilibrium in fish within two minutes. Efficacy is influenced by acid pH and for some species, by temperature, but not by water hardness, age of quinaldine solutions, or repeated exposures of fish to quinaldine. Assets include rapid action and prolonged maintenance of anesthesia, but anesthetized fish retain a degree of reflex responsiveness which may interfere with stripping, delicate surgical operations, and blood collection. The drug is harmless to fertilized rainbow trout eggs at concentrations and exposure times normally encountered in spawning operations. (Authors)

11145. Marking, Leif L. (Fish Control Lab., Bur. of Sport Fisheries and Wildlife, La Crosse, Wis.). 1969. INVESTIGATIONS IN FISH CONTROL 23. TOXICITY OF QUINALDINE TO SELECTED FISHES. Bureau of Sport Fisheries and Wildlife Investigations in Fish Control 23. 10 p.

Quinaldine, an anesthetic for fish, is toxic to various sizes of rainbow trout, brown trout, brook trout, lake trout, northern pike, channel catfish, bluegills, largemouth bass, and walleyes in 15-, 30-, and 60-minute and 3-, 6-, 24-, 48-,

and 96-hour static bioassays. Toxic concentrations range from 2.0 to 25 ppm in standard tests at 12° C in 96 hours. Its toxicity to rainbow trout is significantly greater at higher temperatures, and 96-hour LC_{50}'s range from 13.3 ppm at 7° C to 1.9 ppm at 17° C. In 6-hour exposures, quinaldine is more toxic at colder temperatures. Bluegills are more sensitive at 22° C than at 12° or 17° C. The anesthetic is more toxic to fish in hard than in soft water, a condition probably associated with pH. Safety indexes show that shorter exposures to quinaldine are safer to fish, although the concentrations may be greater than required in longer exposures. Recovery from anesthesia is good among survivors in fish exposed to partial-kill concentrations of quinaldine for 96 hours. (Auth.)

11146. Locke, David O. (Maine Dept. of Inland Fisheries and Game, Augusta, Me.). 1969. INVESTIGATIONS IN FISH CONTROL 24. QUINALDINE AS AN ANESTHETIC FOR BROOK TROUT, LAKE TROUT, AND ATLANTIC SALMON. Bureau of Sport Fisheries and Wildlife Investigations in Fish Control 24. 5 p.

Quinaldine (2-methylquinoline) was an effective anesthetic for yearling Atlantic and landlocked salmon and brook and lake trout in waters ranging from 10 to 40 ppm total hardness and temperatures ranging from 36° to 40° F. and from 47° to 59° F. Lake trout were more sensitive than the other species tested. In tests, anesthetization and recovery rates for five concentrations (5, 10, 15, 20, and 25 ppm) at both temperatures (10 ppm) was generally satisfactory for lake trout. A concentration of 15 ppm was satisfactory for marking and general handling of salmon and brook trout. Quinaldine is one twenty-fourth as expensive as MS-222 at 1:12,000, and in view of our excellent results this drug warrants wider use as a fish anesthetic. (Auth.)

11147. Burress, Ralph M., and Charles W. Luhning (Southeastern Fish Control Lab., Bur. of Sport Fisheries and Wildlife, Warm Springs, Ga.). 1969. INVESTIGATIONS IN FISH CONTROL 25. FIELD TRIALS OF ANTIMYCIN AS A SELECTIVE TOXICANT IN CHANNEL CATFISH PONDS. Bureau of Sport Fisheries and Wildlife Investigations in Fish Control 25. 11 p.

Antimycin effectively and economically controlled heavy infestations of green sunfish and golden shiners from selected channel catfish ponds at a Mississippi fish farm. An initial application of 5 ppb of antimycin in two ponds and 7.5 ppb in the third pond eliminated nearly 99% of the scalefishes. A followup treatment of 10 ppb, 4 days later, further reduced these populations with no apparent effect on yearling catfish. At harvest, three untreated ponds produced 1,474 pounds of scalefishes or an average of 389 pounds per acre, yielded 27.4% or 1,155 fewer catfish than the three treated ponds, and contained 1,183 undersize fish or nearly three times as many that were too small for table use. Comparison of the adjusted yields of catfish from treated and untreated ponds, ranging in size from 0.94 to 1.39 acres, indicates that treated ponds produced an additional 1,015 pounds of fish worth $507.50, while antimycin cost only $145.79—a net return of $2.48 for each dollar invested in toxicant. (Authors)

11148. Berger, Bernard L., Robert E. Lennon, and James W. Hogan (Fish Control Labs., Bur. of Sport Fisheries and Wildlife, La Crosse, Wis.). 1969. INVESTIGATIONS IN FISH CONTROL 26. LABORATORY STUDIES ON ANTIMYCIN A AS A FISH TOXICANT. Bureau of Sport Fisheries and Wildlife Investigations in Fish Control 26. 21 p.

Liquid and sand formulations of antimycin A were tested in laboratory waters of various temperature, hardness, pH, and turbidity against 31 species of freshwater fish of various sizes and life stages. Each formulation of toxicant was lethal under all water conditions to fish eggs, fry, fingerlings, and adult fish. Trouts are the mose sensitive and catfishes the least sensitive. Of the 31 species, 24 succumb to 5 ppb or less of the toxicant; only certain catfishes survive 25 ppb. The order of toxicity to various species of fish suggest that antimycin has possibilities for selective or partial control of certain unwanted fish. Although toxic to fish under ice, antimycin is more active in warm water than in cold. It is slightly more active in soft water than in hard; it is more active and persists far longer in

water at pH 5 to 8 than at pH 9 or 10. It is active on fish in either clear and turbid waters, and it can be detoxified by potassium permanganate. The results contributed to registration of antimycin A in Fintrol-5 formulation as a fish toxicant. (Authors)

11149. Gilderhus, Philip A., Bernard L. Berger, and Robert E. Lennon (Fish Control Labs., Bur. of Sport Fisheries and Wildlife, La Crosse, Wis.). 1969. INVESTIGATIONS IN FISH CONTROL 27. FIELD TRIALS OF ANTIMYCIN A AS A FISH TOXICANT. Bureau of Sport Fisheries and Wildlife Investigations in Fish Control 27. 21 p.

Antimycin A was subjected to field trials as a fish toxicant in 20 ponds and lakes and 5 streams in the East, Midwest, and West of the United States. The formulations of toxicant included three on sand grains which are designed to release antimycin uniformly within certain depths, and one formulation in a liquid. Ten parts per billion or less of the toxicant were effective against most of the 54 species of fish we encountered, including carp, suckers, and green sunfish. Differences in sensitivity among fish suggest possible use of antimycin as a selective toxicant. The efficacy of the toxicant is influenced by pH and water temperature, with slightly higher concentrations necessary at high pH or in cold water. Antimycin does not repel fish, and its toxic action on fish appears to be irreversible. It degrades rapidly, usually within a week. Fish-killing concentrations have little or no effect on other aquatic animals. (Authors)

11150. Burress, Ralph M., and Charles W. Luhning (S. E. Fish Control Lab., Bur. of Sport Fish. & Wildlife, Warm Springs, Ga.). 1969. INVESTIGATIONS IN FISH CONTROL 28. USE OF ANTIMYCIN FOR SELECTIVE THINNING OF SUNFISH POPULATIONS IN PONDS. Bureau of Sport Fisheries and Wildlife Investigations in Fish Control 28. 9 p.

Selective removal of bluegills, redear sunfish, and redbreast sunfish was accomplished in six soft-water ponds in west central Georgia by applications of 0.4, 0.6, 0.8, and 1.0 ppb of antimycin in the Fintrol-5 formulation. Successful treatments were made during winter, spring, and late summer at water temperatures ranging from 46° to 75° F and under a wide variety of weather conditions. The amount of toxicant applied per treatment was calculated according to total pond volume. The 0.4-ppb treatment made at 75° F removed 2.9 pounds per acre of largemouth bass less than 6 inches long and 69 pounds per acre of all sizes of sunfishes. The 0.6-ppb treatment applied at 47° F reduced the numbers of bluegills less than 4 inches in length by about half with very little effect on largemouth bass or larger bluegills. Bass, bluegills, and redear sunfish which survived multiple exposures to antimycin in concentrations up to 1.0 ppb were able to reproduce normally. The toxicant is easy to apply, and costs only $0.64 per acre-foot at the 0.4-ppb concentration. (Authors)

11151. Howland, Robert M., and Richard A. Schoettger (Fish Control Labs., Bur. of Sport Fisheries and Wildlife, La Crosse, Wis.). 1969. INVESTIGATIONS IN FISH CONTROL 29. EFFICACY OF METHYLPENTYNOL AS AN ANESTHETIC ON FOUR SALMONIDS. Bureau of Sport Fisheries and Wildlife Investigations in Fish Control 29. 10 p.

Effective concentrations of methylpentynol for anesthetizing rainbow trout, brown trout, brook trout, and lake trout were determined by a series of tests. Concentrations of 1.5 to 8 ppt induced anesthesia in 4 to 57 minutes. Increase in water temperature accelerated anesthesia. Changes in pH or in water hardness had no significant effect on the rate of anesthesia. Repeated anesthesia had little effect on rate of response. The efficacy of anesthetic solutions was reduced by continuous use. Approximately 1 kilogram of rainbow trout could be effectively narcotized per milliliter of drug. Methylpentynol was compared with MS-222 as a fish anesthetic. Fifty times as much methylpentynol was necessary to yield the equivalent effect of 100 ppm of MS-222. Methylpentynol may be more appropriate as a sedative or soporific for salmonids than as an anesthetic. (Authors)

11152. Marking, Leif L. (Fish Control Labs., Bur. of Sport Fisheries and Wildlife, La Crosse, Wis.). 1969. INVESTIGATIONS IN FISH CONTROL 30. TOXICITY OF METHYLPENTYNOL TO SELECTED FISHES. Bureau of Sport Fisheries and Wildlife Investigations in Fish Control 30. 7 p.

Methylpentynol was tested in 96-hour bioassays for its toxicity to rainbow trout, brown trout, brook trout, lake trout, northern pike, channel catfish, bluegills, largemouth bass, and walleyes. The LC_{50}'s range from 660 to 1,890 ppm at 12° C. Channel catfish are the most resistant and lake trout are the most sensitive. Two-inch rainbow trout, brown trout, and lake trout are more sensitive to methylpentynol than larger ones in 96-hour exposures. The drug is more toxic to bluegills at 17° C than at 12° C. Toxicity was not influenced in different water hardnesses of 10 to 180 ppm. (Auth.)

11153. Svendsen, Gerald E. (Fish Control Labs., Bur. of Sport Fisheries and Wildlife, La Crosse, Wis.). 1969. INVESTIGATIONS IN FISH CONTROL 31. ANNOTATED BIBLIOGRAPHY ON METHYLPENTYNOL. Bureau of Sport Fisheries and Wildlife Investigations in Fish Control 31. 7 p.

An annotated bibliography containing 26 selected references on the biochemistry, physiology, and methods of analysis of methylpentynol. (Auth.)

11154. Walburg, Charles H. (North Central Reservoir Invest., Bur. of Sport Fisheries and Wildlife, Yankton, S. D.). 1969. FISH SAMPLING AND ESTIMATION OF RELATIVE ABUNDANCE IN LEWIS AND CLARK LAKE. Bureau of Sport Fisheries and Wildlife Technical Paper 18. 15 p.

Catches by gill nets, frame nets, trap nets, 4.9- and 8.2-meter otter trawls, seines, and a 220-volt electroshocker, from 1962 to 1964, were compared to determine practical methods for annual measuring of the fish population in Lewis and Clark Lake. Analyses of catch-effort data indicated that seines and 8.2-meter trawls were most efficient for sampling young-of-the-year, and trap and gill nets were most efficient for sampling older fish. It was calculated that the relative abundance of age I and older fish of most species could be estimated within 20% of true value (observed mean catch per unit of effort), and 95% confidence, with four trap nets and four gill nets fished for 30 days. Fishing gear, location, and time of sampling must be similar each year. (Auth.)

11155. Mullan, James W., and Richard L. Applegate (South Central Reservoir Invest., Bur. of Sport Fisheries and Wildlife, Fayetteville, Ark.). 1969. USE OF AN ECHOSOUNDER IN MEASURING DISTRIBUTION OF RESERVOIR FISHES. Bureau of Sport Fisheries and Wildlife Technical Paper 19. 16 p.

A recording white-line depth sounder was used to study annual fish distribution in two deep reservoirs on the White River, Arkansas and Missouri. Varying seasonal activity levels of fish, attenuation of the sound beam at depths over 100 feet, and lack of precision in the identification of echo traces precluded rigorous interpretation of echograms. The inherent picture sense of echograms provided seasonal perspectives of fish distribution with respect to (1) diel movement, (2) depth and basin location, (3) limnetic concentrations, and (4) oxygen-temperature conditions. Scattering layers associated with planktonic chaoborid populations and suspected chemical constituents were disclosed in one of the reservoirs undergoing initial filling. (Authors)

11156. Heimstra, Norman W., David K. Damkot, and Norman G. Benson (Univ. of South Dakota, Vermillion, S. D.). 1969. SOME EFFECTS OF SILT TURBIDITY ON BEHAVIOR OF JUVENILE LARGEMOUTH BASS AND GREEN SUNFISH. Bureau of Sport Fisheries and Wildlife Technical Paper 20. 9 p.

Behavior of juvenile largemouth bass and green sunfish in aquariums was measured under conditions of clear water, 4-6 JTU (Jackson Turbidity Units), and 14-16 JTU for 30 days. The activity of bass was significantly reduced by turbidity; sunfish activity was reduced, but not significantly. Feeding and attack behavior was not influenced. Scraping behavior of both species was higher under turbid conditions. There was evidence that turbidity disturbed normal social hierarchies in green sunfish. (Authors)

11157. Nelson, William R. (North Central Reservoir Invest., Bur. of Sport Fisheries and Wildlife, Yankton, S. D.). 1969. BIOLOGICAL CHARACTERISTICS OF THE SAUGER POPULATION IN LEWIS AND CLARK LAKE. Bureau of Sport Fisheries and Wildlife Technical Paper 21. 11 p.

Age and rate of growth, sex ratio, maturity, fecundity, movement, and exploitation rates were determined for the sauger (Stizostedion canadense) population in Lewis and Clark Lake and the Missouri River between Gavins Point and Fort Randall dams. The body-scale relation of 1, 529 fish was described by a straight line. Annulus formation began in late May for immature fish, mid-June for mature fish, and was complete by early July. Growth in length was equal to or greater than that recorded from other areas. Growth improved after impoundment of the reservoir and remained relatively stable from 1957 to 1963 with a decline in 1964. There were only slight differences in length-weight relation between sauger from Lewis and Clark Lake and those from other areas. Males matured earlier than females but were shorter lived. Fecundity was similar to that reported for other areas. Marking studies revealed mature sauger left the reservoir in the fall, moved into the Missouri River, and concentrated in the tailwater of Fort Randall Dam. After spawning in the spring they returned to the reservoir. Return of tags by anglers revealed a low harvest of sauger in the reservoir; most tags were recovered from tailwater areas. Poor return of tags from Lewis and Clark Lake was attributed to light fishing effort and reduced vulnerability to anglers when fish are dispersed throughout the reservoir. Annual angler harvest in Fort Randall tailwater for fish older than age group I ranged from 10.4 to 33.3%; it averaged 21.4% from 1954 to 1957, and 18.1% in 1963. Suggested management measures for sauger include introduction of forage fish to improve growth, increased angler harvest, and reduction of water level fluctuation on spawning grounds to improve year-class strength. (Auth.)

11158. Siefert, Richard E. (North Central Reservoir Invest., Bur. of Sport Fisheries and Wildlife, Yankton, S. D.). 1969. BIOLOGY OF THE WHITE CRAPPIE IN LEWIS AND CLARK LAKE. Bureau of Sport Fisheries and Wildlife Technical Paper 22. 16 p.

White crappie, Pomoxis annularis (Rafinesque), in Lewis and Clark Lake spawned from May 27 to July 1, 1966; peak in spawning was from June 14 to 24. Little or no successful reproduction has occurred in the open areas of the reservoir since 1962, but reproduction has occurred in most protected areas. Young fish emigrate from spawning-nursery areas into the open reservoir during the first summer of life. Length range of young-of-the-year reached a maximum (15 to 90 millimeters) during the last two weeks of August, and by late autumn fish up to 105 mm were captured. Zooplankton were the total diet of early stage larvae (4.5 to 15.5 mm long) and the most important food of larger young-of-the-year. Young fish fed mainly during daylight hours. Growth, calculated from scale collections of age I and older fish taken in 1963-66, has improved in recent years. Fish became sexually mature at an earlier age in 1966 than in 1963-64. Year-class strength has fluctuated; the strongest occurred the first year after impoundment (1956), and after three consecutive years of poor relative strength, strong year classes were produced in 1962 and 1963. Preferred diet of age I and older fish was zooplankton followed by insect material, especially Hexagenia. White crappie growth after the first season of life appears related to the population density of Hexagenia. (Auth.)

11159. McNeil, William J., Stephen C. Smedley, and Robert J. Ellis (Bur. of Commercial Fisheries Biological Lab., Auke Bay, Alaska). 1969. TRANSPLANTING ADULT PINK SALMON TO SASHIN CREEK, BARANOF ISLAND, ALASKA, AND SURVIVAL OF THEIR PROGENY. Bureau of Commercial Fisheries Special Scientific Report--Fisheries No. 587. 9 p.

The return of adult pink salmon, Oncorhynchus gorbuscha, to Sashin Creek was very low in the even years from 1946 to 1962. In 1964 an experiment tested a method of transplanting adults to reestablish the even-year run of pink salmon. About 2, 400 adult pink salmon were captured in a purse seine in Bear Harbor and

transported alive in brine tanks on a boat to Sashin Creek, a distance of about 80 km (50 miles). Most of the fish survived the trip; 727 males and 1, 139 females were put into Sashin Creek above a weir. The transplanted fish were augmented by 166 females and 121 males of unknown origin that entered the stream naturally. The distribution of the spawners in the stream was similar to that of native runs of the same size. Survival of the eggs and progeny from a potential deposition of 2, 230, 000 eggs was relatively good for Sashin Creek--55% to the end of spawning and 14% to fry emergence the next spring. The survival of these fish in the ocean was also relatively good, and about 6, 000 adults (2% of the fry) returned to spawn in 1966. These fish spawned successfully, and survival of fry in 1967 from the potential egg deposition was 12%. (Authors)

11160. Bureau of Commercial Fisheries. 1969. FISHERY PUBLICATION INDEX, 1955-64. PUBLICATIONS OF THE FISH AND WILDLIFE SERVICE BY SERIES, AUTHORS, AND SUBJECTS. Bureau of Commercial Fisheries Circular 296. 240 p. For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. Pr. $1. 75.

11161. Alexander, Gaylord R., and David S. Shetter. 1969. TROUT PRODUCTION AND ANGLING SUCCESS FROM MATCHED PLANTINGS OF BROOK TROUT AND RAINBOW TROUT IN EAST FISH LAKE, MICHIGAN. J. Wildlife Mgmt., 33(3): 682-692.

We studied survival, growth, exploitation, and production from five consecutive matched plantings of brook trout (Salvelinus fontinalis) and rainbow trout (Salmo gairdneri) (8. 5-9. 5 inches long) in East Fish Lake, Montmorency County, Michigan, 1958-62. Stocked fish were given varying fin clips for later recognition. Population numbers at several intervals between introductions were determined by Petersen-type estimates. Angler exploitation was tabulated from a complete creel census. Rainbow trout survival was about 98% from stocking in October to the following fishing season in April, whereas brook trout survival averaged only 49%. About one-third of brook trout deaths occurred between October 15 and the date of ice formation (approx. December 15). Brook trout stayed in shallow water along shore more than did rainbow trout. Anglers caught 86% of the stocked rainbow trout, but only 39% of the brook trout. For each pound of trout stocked, anglers caught 3. 59 pounds of rainbow trout, but only 0. 76 pounds of brook trout. In addition to the better return on a poundage basis, rainbow trout provided a fishery throughout the angling season, whereas nearly all brook trout were caught during the first 10 days. The brook trout grew well (average increment 0. 9 lb/yr), but the rainbow trout averaged 1. 3 pound increment per year. Possibly a greater poundage return on rainbow trout would accrue if the beginning of the angling season could be delayed to take advantage of the early summer growing season. (Authors)

11162. Chadwick, George G., and Robert W. Brocksen (Dept. of Fisheries and Wildlife, Oregon State Univ., Corvallis, Oreg.). 1969. ACCUMULATION OF DIELDRIN BY FISH AND SELECTED FISH-FOOD ORGANISMS. J. Wildlife Mgmt., 33(3): 693-700.

The rate of uptake of 1, 2, 3, 4, 10, 10-hexachloro-6, 7-epoxy-1, 4, 4a, 5, 6, 7, 8, 8a-octa-hydro-1, 4-endo, exo-5, 8-dimethanonaphthalene (a component of dieldrin abbreviated HEOD) from contaminated water or food by the reticulate sculpin (Cottus perplexus) and fish-food organisms, turbificid worms (Tubifex sp.) and midge larvae (Chironomidae) was determined. Fish were held in aquaria with continuously renewed water that had concentrations of HEOD ranging from 0. 017 to 8. 6 ppb. Accumulation of HEOD by the fish was dependent on its concentration in the water, and the accumulation was nearly constant at each exposure level during the 32-day test period. The saturation level of HEOD in the fish apparently was never reached. Feeding experiments, using contaminated tubificid worms as the food source, showed that the retention of HEOD by fish was inversely related to the amount of HEOD they consumed. Fish retained nearly all of the HEOD they consumed when given small amounts in their food, but they retained a much lower proportion

of the available HEOD when given large amounts in food. Feeding duration (up to 30 days) of the fish had little effect upon their retention of HEOD. It is evident that fish can accumulate HEOD both from the surrounding water and from their food, but accumulation of HEOD from the water does not appear to be additive with the HEOD accumulated from the food. Fish held in water having a concentration of 0.5 ppb HEOD, and fed worms containing known amounts of HEOD, did not accumulate more HEOD than fish held in the same concentration of HEOD and fed uncontaminated worms. (Authors)

11163. Buerkle, Udo (Fish. Res. Board of Canada Biological Sta., St. Andrews, N.B., Canada). 1969. AUDITORY MASKING AND THE CRITICAL BAND IN ATLANTIC COD (Gadus morhua). J. Fish. Res. Bd. Canada, 26(5): 1113-1119.

Auditory masking was determined for cod by using five half-octave bands as masking stimuli and as signals. For each of 15 cod, masking noise was kept constant at 10 db re 1 microbar in one band while thresholds were determined for signals in all five bands. Results indicate masking to be most pronounced when noise and signal coincide in frequency, and to drop off as frequency separation between noise and signal increases. Masking is calculated in terms of threshold in relation to masking noise level, and varies from about 11 db when signal and noise are in the same band to about -19 db when they are in bands furthest removed from each other. Estimates of critical bands are made from the results. (Auth.)

11164. McBride, J.R., and A.P. van Overbeeke (Fish. Res. Board of Canada, Vancouver Lab., Vancouver, B C., Canada). 1969. CYTOLOGICAL CHANGES IN THE PITUITARY GLAND OF THE ADULT SOCKEYE SALMON (Oncorhynchus nerka) AFTER GONADECTOMY. J. Fish. Res. Bd. Canada, 26(5): 1147-1156.

Effects of gonadectomy on the cytological structure of the pituitary gland of sockeye salmon were investigated. Castration of fully grown, but sexually immature, fish appeared to prevent differentiation of any periodic acid-Schiff (PAS) positive cells. On the other hand, castration of mature sockeye induced degranulation of this cell type. These cells later disintegrated. Although the acidophil cells of the proximal pars distalis in the immature castrates showed an apparent increase in number, those in the gonadectomized ripe fish exhibited marked hyperplasia and hypertrophy. In view of the "rejuvenation", including the considerable increase in body weight that occurs after castration of sexually ripe sockeye, it is thought that the changes in the acidophils noted in this experiment may reflect an increased production of growth hormone. Where the gonadectomy was incomplete it was noted that very small remnants of gonad were able to induce, or maintain, all the external secondary characteristics of full sexual maturity. The pituitary of these fish exhibited cytological features intermediate between those of the controls and the complete castrates. (Authors)

11165. Lee, Agnes S.K., William E. Vanstone, John R. Markert, and Naval J. Antia (Fish. Res. Board of Canada, Vancouver, Lab., Vancouver, B.C., Canada). 1969. UV-ABSORBING AND UV-FLUORESCING SUBSTANCES IN THE BELLY SKIN OF FRY OF COHO SALMON (Oncorhynchus kisutch). J. Fish. Res. Bd. Canada, 26(5): 1185-1198.

The belly skin of 4-month-old coho salmon fry was extracted with 0.5 M NH_4OH, and the extract was analyzed by paper chromatography for UV-absorbing and UV-fluorescing substances. Six fluorescing and three absorbing substances were isolated and characterized by Rf values, UV-absorption spectra, and chemical reactions, and were identified with known compounds where possible. The three UV-absorbing substances were identified as guanine, hypoxanthine, and inosine monophosphate. Three of the UV-fluorescing substances were identified as ichthyopterin, pterin 6-carboxylic acid, and 7, 8-dihydroxanthopterin. A fourth fluorescing substance appeared to be an artefact produced by the action of NH_4OH on ichthyopterin. The remaining two fluorescing substances appeared to be unknown glycosides, presumably isomers, both containing glucose, xylose, and mannose. (Authors)

11166. Bilton, H. T., and D. W. Jenkinson (Fish. Res. Board of Canada Biological Sta., Nanaimo, B. C., Canada). 1969. AGE DETERMINATION OF SOCKEYE (Oncorhynchus nerka) AND CHUM (O. keta) SALMON FROM EXAMINATION OF PECTORAL FIN RAYS. J. Fish. Res. Bd. Canada, 26(5): 1199-1203.

Ages of adult sockeye and chum salmon were estimated from examination of the second anterior pectoral fin ray, and were compared with estimates from their scales or otoliths. For sockeye, only the ocean age could be estimated. Freshwater annual rings could not be distinguished on their fin rays even though they were present on their scales or otoliths. In general, the three methods provided the same estimates of ocean age. Agreement of estimates of ocean age by one to five readers ranged from 78.9 to 98.8%. For chum salmon, the scale and fin ray methods generally provided the same estimates of total age. Agreement of estimates of total age by one or two readers ranged from 73.8 to 99.3%. (Authors)

11167. Jahn, Lawrence A. (Dept. of Zoology and Entomology, Montana State Univ., Bozeman, Mont.). 1969. MOVEMENTS AND HOMING OF CUTTHROAT TROUT (Salmo clarki) FROM OPEN-WATER AREAS OF YELLOWSTONE LAKE. J. Fish. Res. Bd. Canada, 26(5): 1243-1261.

Cutthroat trout (Salmo clarki) showed in-season homing after displacement from their spawning tributaries to Yellowstone Lake during June-August 1966 and 1967. Of 300 nonanesthetized trout tagged and displaced from Clear and Cub creeks to three release points (0.5-22.0 km) in the lake and to the mouth of Clear Creek, 38.3% homed, 10.0% strayed, 2.7% were caught by anglers, and the remainder were unaccounted for. Anosmic (olfactory chambers plugged) and blind-anosmic fish homed in significantly lower percentages than nonanesthetized and control groups. Fish released just outside the mouth of the homestream had the shortest average homing time, but the average homing time for fish displaced 22.0 km from the homestream was shorter than for those displaced 5.0 km away. Homing percentages for trout tagged after being tracked individually in the open lake were similar to those for trout in the group tagging experiments, but the former had longer average homing times than the latter. The directions of orientation of fish tracked in open water were generally toward the homestream, the directions usually coinciding with those of the sun azimuth. However, fish taken from the east side of the lake went west-northwest when tracked late in the afternoon and fish taken from the west side of the lake went east-southeast when tracked in the morning, these directions being away from those of the homestreams. Orientation was affected by current. Mean directions for males and females were generally not significantly different. Average swimming speeds and vector lengths for males and females were about the same. Immature cutthroat trout were trained to use a light source as a reference point for orientation. (Auth.)

11168. Weber, Douglas, and Roy J. Wahle (Bur. of Commercial Fisheries Biological Lab., Seattle, Wash.). 1969. EFFECT OF FINCLIPPING ON SURVIVAL OF SOCKEYE SALMON (Oncorhynchus nerka). J. Fish. Res. Bd. Canada, 26(5): 1263-1271.

A finclip and a chemical (tetracycline) mark were applied, in similar numbers, to hatchery-reared fingerling sockeye salmon (Oncorhynchus nerka). In mark-sampling of returning adults 3 and 4 years after release from the hatchery, numerical comparison of fish with the two marks showed that fewer finclipped fish returned than expected. It was demonstrated that the tetracycline mark did not affect survival and that the difference between returns of fish with the two marks originated in mortality caused by finclipping. The mortality attributed to finclipping was estimated as 39%. (Authors)

11169. Narver, David W. (Fish. Res. Board of Canada Biological Station, Nanaimo, B. C., Canada). 1969. PRODUCTIVITY OF OWIKENO LAKE, BRITISH COLUMBIA. J. Fish. Res. Bd. Canada, 26(5): 1363-1368.

Although Owikeno Lake is the third highest producer of adult sockeye salmon in North America in terms of mean annual total return (catch plus escapement) per unit of lake nursery area, limited measurements of other indices of lake productivity

suggest that its primary productivity is much lower than that of the other four highest sockeye-producing lakes. The implications of these results to sockeye production are discussed. (Auth.)

11170. Li, M. F., and Carol Jordan (Fish. Res. Board of Canada, Halifax Lab., Halifax, N. S., Canada). 1969. USE OF SPINNER CULTURE CELLS TO DETECT WATER POLLUTION. J. Fish. Res. Bd. Canada, 26(5): 1378-1382.

The sensitivity of L-cells (spinner culture) to several pesticides and a herbicide was determined. The inhibition of L-cells growth was marked and in the case of DDT was shown to be strictly concentration-dependent. The simplicity and reproducibility of the assay system should make it a useful tool in water pollution studies. (Authors)

11171. Lander, R. H. (Bur. of Commercial Fisheries Biological Lab., Seattle, Wash.). 1969. SWIMMING THRUST OF SOCKEYE SALMON (Oncorhynchus nerka) IN RELATION TO SELECTIVITY OF GILLNETS. J. Fish. Res. Bd. Canada, 26(5): 1383-1385.

A significant relationship between girth at the mesh mark and fork length indicates that long sockeye salmon (Oncorhynchus nerka) have more swimming thrust that short ones. This tends to confirm a speculation of Regier and Robson (J. Fish. Res. Bd. Canada 23: 423-454, 1966). Preliminary conjecture relates the observation to the theory of mesh selectivity. (Auth.)

11172. Graybill, J. R., and H. F. Horton (Dept. of Fisheries and Wildlife, Oregon State Univ., Corvallis, Oreg.). 1969. LIMITED FERTILIZATION OF STEELHEAD TROUT EGGS WITH CRYO-PRESERVED SPERM. J. Fish. Res. Bd. Canada, 26(5): 1400-1404.

Results are reported on the fertilization (to 18%) of steelhead trout (Salmo gairdneri) eggs with cryo-preserved sperm. Fresh semen was progressively diluted to 1:4 with an extender containing 5 or 12.5% dimethyl sulfoxide, sealed in 1.0-ml ampoules, frozen in the vapor of liquid nitrogen, and subsequently thawed in a 4° C water bath. The fertilized eggs and alevins produced appeared normal when compared with those from fresh spermatozoa. (Authors)

11173. Willock, Thomas A. (Natl. Museum of Natural Sciences, Natl. Museums of Canada, Ottawa, Ont., Canada). 1969. DISTRIBUTIONAL LIST OF FISHES IN THE MISSOURI DRAINAGE OF CANADA. J. Fish. Res. Bd. Canada, 26(6): 1439-1449.

The presence of possible migration routes between the Missouri (Gulf of Mexico) and adjacent Saskatchewan (Hudson Bay) drainages is briefly discussed in regard to postglacial dispersal of freshwater fishes. A checklist of 9 families and 27 species of fish recorded from the Milk and Frenchman Rivers of Alberta and Saskatchewan is provided. Two of these are new to the Missouri ichthyofauna of Canada and definite records of 10 species are reported for the first time from the Missouri drainage of Saskatchewan. Notes are included on the distribution of all known species within the Missouri drainage of Canada. The possible presence of three additional species is discussed. (Auth.)

11174. Billi, James L., and Ken Wolf (Bur. of Sport Fisheries and Wildlife, Eastern Fish Disease Lab., Kearneysville, W. Va.). 1969. QUANTITATIVE COMPARISON OF PERITONEAL WASHES AND FECES FOR DETECTING INFECTIOUS PANCREATIC NECROSIS (IPN) VIRUS IN CARRIER BROOK TROUT. J. Fish. Res. Bd. Canada, 26(6): 1459-1465.

Paired fecal samples and peritoneal washes were taken from 300 18-month-old brook trout for determining their relative value in detecting IPN virus. The testing of feces revealed 14 times as many carriers as were found by peritoneal washes. Initial examinations showed at least 63% of the fish to be carriers of the virus, but 30% more were detected in four additional tests. Fecal output of virus from 37 fish was quantified up to five times during a period of 7 months which included the spawning season. Although there were exceptions, fish with high outputs of virus

tended to maintain that level, and low titer carriers tended to yield small amounts, and in some instances, no virus. Tests of fecal extracts which were pooled from 5, 10, and 15 fish showed that virus was readily detected in all three. For economy and efficiency, the use of 10- or 15-sample pools is recommended for determining the presence of IPN in fish. (Authors)

11175. Hunt, Robert L. (Dept. of Natural Resources, Div. of Conservation, Waupaca, Wis.). 1969. OVERWINTER SURVIVAL OF WILD FINGERLING BROOK TROUT IN LAWRENCE CREEK, WISCONSIN. J. Fish. Res. Bd. Canada, 26(6): 1473-1483.

Overwinter survival of brook trout (Salvelinus fontinalis) from the 9-month-old fingerling stage to the 16-month-old yearling stage varied from 35 to 73% during 11 successive winters (1954-65). Mean survival through these first winters of life was 54%. Survival appeared to be independent of fingerling density most winters, and especially when September densities were less than 2,200/km, as they were during 7 of 11 years. Overwinter survival tended to increase with an increase in mean length of fingerling stocks ($r = 0.83^{++}$) and with an increase in winter water temperatures. Intraspecific predation did not appear to be a critical mortality factor. The survival advantage of increased fingerling size was probably related to increased physiological resistance to temperature-associated stresses rather than reduced vulnerability to predation. (Auth.)

11176. Leggett, William C., and G. Power (Dept. of Biology, Univ. of Waterloo, Waterloo, Ont., Canada). 1969. DIFFERENCES BETWEEN TWO POPULATIONS OF LANDLOCKED ATLANTIC SALMON (Salmo salar) IN NEWFOUNDLAND. J. Fish. Res. Bd. Canada, 26(6): 1585-1596.

Differences in growth rates, longevity, fecundity, and time of spawning between two populations of landlocked Atlantic salmon (Salmo salar) in Newfoundland were attributed to food quality and quantity. Salmon in Flatwater Pond, an oligotrophic lake with a poor invertebrate population and no forage fish, grew slowly (145 mm at age 2+, 245 mm at age 5+), suffered high mortality (approximately 60% in males after age 2+ and in females after age 3+), had very low fecundity (an average of 153 eggs per female), and were sexually mature by late August. Salmon in Gambo Pond, an oligotrophic lake with a good invertebrate population and an ample forage fish population in the form of Gasterosteus aculeatus, grew more rapidly reaching 157 mm at age 2+, 367 mm by age 5+, and 437 mm by age 8+. Longevity of the Gambo Pond stock was greater than that of Flatwater Pond (39.6% of the Gambo sample were older than 4+ years compared with 3.2% for Flatwater Pond). Gambo Pond salmon are not sexually mature until October. Salmon in both lakes exhibited seasonal movement into deeper water when the surface warmed above 14° C. At Flatwater Pond this movement contributed to an early end to the growing season. Scale reading was found to be an unreliable method for determining past spawning activity. Spawning marks were found on only 1 of 17 females known to have spawned previously. (Authors)

11177. Phinney, Duane E., and Stephen B. Mathews (Fish. Res. Inst., Univ. of Washington, Seattle, Wash.). 1969. FIELD TEST OF FLUORESCENT PIGMENT MARKING AND FINCLIPPING OF COHO SALMON. J. Fish. Res. Bd. Canada, 26(6): 1619-1624.

Three lots of age 0 coho salmon were placed in a 6-acre dirt pond. Fish in one lot were marked with fluorescent pigment; those in a second lot were marked with a finclip; and those in a third lot were unmarked. Rainbow trout and age 1 coho were also placed in the pond as potential predators on the fry. After 6 months, sampling of the fry indicated that the fluorescent pigment lot survived and grew as well as the unmarked lot, but that the finclipped lot did not fare as well as the other in terms of survival and growth. (Authors)

11178. Zawacki, Chester S. 1969. LONG ISLAND'S ARTIFICIAL FISHING REEFS. The Conservationist, 24(1): 18-21.

11179. LeBrasseur, R.J. (Fish. Res. Board of Canada Biological Sta., Nanaimo, B.C., Canada). 1969. GROWTH OF JUVENILE CHUM SALMON (Oncorhynchus keta) UNDER DIFFERENT FEEDING REGIMES. J. Fish. Res. Bd. Canada, 26(6): 1631-1645.

Juvenile chum salmon were fed on six different concentrations of size-selected zooplankton for 8 weeks. Zooplankton were caught daily and sorted through sieves into size-groups roughly as follows: 6-20 mm total length, mainly euphausiids; 2.5-4.5 mm, mainly copepods; and $\leq$ 1.5 mm, mainly small copepods. The rate of growth in weight of the fish was found to be dependent upon the concentration of the ration. Fish which were offered no food lost weight, and fish which were offered excess food increased in weight by 5.4% per day. The mean growth rate of the fish held on fixed rations ranged from 2.2 to 5.7% per day and was found to be independent of the type of prey. Electivity experiments showed that all the fish selected copepods 1.6-4.5 mm long in proportion to their abundance and rejected copepods $\leq$ 1.5 mm. The euphausiids were selected only by fish which had previously fed on euphausiids. The effect of variations in the availability of prey is discussed. (Auth.)

11180. Houde, Edward D. (Dept. of Conservation, Cornell Univ., Ithaca, N.Y.). 1969. SUSTAINED SWIMMING ABILITY OF LARVAE OF WALLEYE (Stizostedion vitreum vitreum) AND YELLOW PERCH (Perca flavescens). J. Fish. Res. Bd. Canada, 26(6): 1647-1659.

Sustained swimming ability of limnetic larvae of walleye and yellow perch from Oneida Lake, New York, was compared in an experimental apparatus. The current velocity that 50% of the larvae could sustain in 1-hour tests was recorded for each 1-mm length class. Yellow perch larvae swam better than walleye larvae for length classes less than 9-10 mm total length (TL), but swimming ability of the two species was equal for length classes from 9 to 15 mm. Velocities that larvae under 9.5 mm TL could sustain were less than 3.0 cm/sec, and it was concluded that newly hatched young of both species would be subject to transport by lake currents of greater velocity. Relative swimming ability, expressed as the number of body lengths/sec that a larva could sustain for 1 hour, approached an asymptote between 3 and 4 lengths/sec for larvae longer than 9.5 mm. The greater swimming ability of newly hatched yellow perch larvae, compared with that of walleyes, appeared to be related to the smaller yolk sac of yellow perch at hatching. (Auth.)

11181. Ducharme, L.J.A. (Resour. Develop. Br., Dept. of Fisheries of Canada, Halifax, N.S., Canada). 1969. ATLANTIC SALMON RETURNING FOR THEIR FIFTH AND SIXTH CONSECUTIVE SPAWNING TRIPS. J. Fish. Res. Bd. Canada, 26(6): 1661-1664.

Six female Atlantic salmon (Salmo salar L.) were captured in Big Salmon River, New Brunswick, in August and September 1967. Examination of the scales revealed that four of these fish had spawned four times and two had spawned five times. All were in fresh water at the time of capture and all had commenced erosion at the margin of their scales. Although many of the previously formed growth rings were destroyed by erosion, enough of the scale patterns were left to permit the interpretation of the life histories of the fish. (Auth.)

11182. Murray, A.R., D.R.L. White, and R.S. Whitaker (Fish. Res. Board of Canada Biological Sta., St. John's, Nfld., Canada). 1969. MUSCLE DAMAGE IN ADULT ATLANTIC SALMON CAUGHT IN NYLON GILLNETS. J. Fish. Res. Bd. Canada, 26(6): 1694-1696.

Ligation of an adult Atlantic salmon with a cord created a bruise in the epaxial muscles similar to that observed in a salmon caught by a nylon gillnet. There were no external manifestations of these lesions. Although only 10 such salmon have been observed, the incidence of this type of damage could be high because of the recent and widespread use of nylon gillnets for Atlantic salmon. (Authors)

11183. Gilbert, Claire K., and Perry W. Gilbert. 1968. RARE AND COMMON SHARKS OFF THE NEW YORK COAST. The Conservationist, 22(4): 21-26, 36-37.

11184. Brown, V. M., D. H. M. Jordan, and B. A. Tiller (Water Pollution Res. Lab., Stevenage, England). 1969. THE ACUTE TOXICITY TO RAINBOW TROUT OF FLUCTUATING CONCENTRATIONS AND MIXTURES OF AMMONIA, PHENOL AND ZINC. J. Fish Biol., 1(1): 1-9.

The experiments showed that the concentrations of ammonia, zinc, and ammonia plus zinc, which were lethal to 50% of a batch of trout within 48 hours were similar, whether fish were immersed in constant concentrations of poisons or in concentrations fluctuating within ±50% of the 48-hour LC_{50} at equal intervals of time, as long as the periodicity of the fluctuations did not exceed the resistance time (that is, the period of exposure after which irreversible changes occur) for the particular poison involved. They also demonstrated that except when zinc predominated in a mixture the fractional toxicities of the three poisons tested here could be summed by the method described, to give the toxicity of the mixture, the 95% confidence intervals effectively embracing the value of 1.0. With zinc predominating (≥70%) in the mixture, however, some possibly antagonistic effect appears to be demonstrated. Quite large differences occurred between the sums obtained by use of the 48-hour LC_{50} values from the present series of tests and those obtained using the standard values; the latter indicated the mixtures to be more toxic than they actually were; in this instance again, except where zinc predominated in the mixture, the results differed significantly from those observed. The slope functions (S) which were obtained showed the test population to have the least variability in response (tolerance) in test a (S=1.17) and the greatest where ammonia or zinc predominated (S=1.25 to 1.27). The importance of this parameter in indicating the degree of damage which would be caused in a population (in terms of death within 48 hours in the present case) has been discussed elsewhere (Brown et al., 1967). Conclusions drawn from such concentration-mortality curves concerning the effects of concentrations of poisons at the upper and lower limits should, however, be accepted with caution because of the inevitable greater sampling error in these regions when small numbers of animals are tested. (Authors)

11185. Mawdesley-Thomas, L. E. (Dept. of Pathology, Huntingdon Research Centre, Huntingdon, England). 1969. FURUNCULOSIS IN THE GOLDFISH Carassius auratus (L.). J. Fish Biol., 1(1): 19-23.

Several outbreaks of furunculosis in the goldfish are described and detailed histology of some of the tissues considered. Only the skin lesions are considered to be diagnostic. Aeromonas salmonicida was the organism cultured from all cases of diseased fish. Treatment with tetracycline, 5 mg/day for five days for fish 400 to 500 g bodyweight, was given by intra-peritoneal injection, which resulted in a complete resolution of the skin lesions. (Auth. summ.)

11186. Cross, D. G. (Salmon and Freshwater Fish. Lab., Ministry of Agriculture, Fisheries and Food, London, England). 1969. AQUATIC WEED CONTROL USING GRASS CARP. J. Fish Biol., 1(1): 27-30.

11187. Mann, R. H. K., and D. R. O. Orr (Freshwater Biol. Assoc., The River Lab., East Stoke, Wareham, Dorset, England). 1969. A PRELIMINARY STUDY OF THE FEEDING RELATIONSHIPS OF FISH IN A HARD-WATER AND A SOFT-WATER STREAM IN SOUTHERN ENGLAND. J. Fish Biol., 1(1): 31-44.

The food of trout, salmon, bullheads, minnows and sticklebacks from a chalk-stream, and trout and minnows from an acid stream were investigated by examination of 2,659 stomachs collected between October 1965 and September 1967. Although fish at each stream feed on similar invertebrate organisms, they do so in different proportions and these proportions may vary with the size of fish, species of fish, season and type of habitat. Variation in fish diets within samples is often greater than between successive monthly samples. Docken's Water trout eat more Plecoptera nymphs and Gammarus than Bere Stream trout, but less Ephemeroptera nymphs and molluscs. (Authors summ.)

11188. Maitland, P. S. (The Nature Conservancy, Edinburgh, Scotland). 1969. A PRELIMINARY ACCOUNT OF THE MAPPING OF THE DISTRIBUTION OF FRESHWATER FISH IN THE BRITISH ISLES. J. Fish Biol., 1(1): 45-58.

Little detailed information is available about the present distribution of freshwater fish in the British Isles. This paper describes a scheme which was started recently to map the distribution of these fish on a 10 km square basis, and discusses some of the preliminary maps just produced. Much further information is required, and any records which can be given from parts of the country not yet covered would be of great value to the scheme. (Auth. summ.)

11189. MacCrimmon, Hugh R., and J. Scott Campbell (Dept. of Zoology, Univ. of Guelph, Guelph, Ont., Canada). 1969. WORLD DISTRIBUTION OF BROOK TROUT, Salvelinus fontinalis. J. Fish. Res. Bd. Canada, 26(7): 1699-1725.

During the past century, the endemic range of the brook trout, Salvelinus fontinalis (Mitchill), has been extended to include western North America and the continents of Europe, Asia, Africa, and South America. Water temperature appears to be the most important single factor limiting the geographic range, but adequate precipitation and suitable spawning areas are necessary also for the establishment of self-sustaining populations. It is improbably that, with the possible exception of Asia, the present range of the brook trout will be greatly extended through further attempts at introduction. (Authors)

11190. Donaldson, Edward M., and Ulf H. M. Fagerlund (Fish. Res. Board of Canada, Vancouver Lab., Vancouver, B. C., Canada). 1969. CORTISOL SECRETION RATE IN GONADECTOMIZED FEMALE SOCKEYE SALMON (Oncorhynchus nerka): EFFECTS OF ESTROGEN AND CORTISOL TREATMENT. J. Fish. Res. Bd. Canada, 26(7): 1789-1799.

Gonadectomized female sockeye salmon (Oncorhynchus nerka) were injected intramuscularly with cortisol, estradiol, estradiol cypionate, or peanut oil for 8 weeks. The metabolic clearance rate of cortisol was determined by the single injection technique and calculated from the formula for a two pool system. The cortisol secretion rate was determined from the metabolic clearance rate and the plasma cortisol concentration. The volume of distribution of cortisol in the inner compartment (V_1) and the outer compartment (V_2), the metabolic clearance rate (MCR), the resting secretion rate (S), and the resting plasma cortisol concentration were all significantly higher in the estradiol-injected group than in the peanut oil-injected control group, and the plasma cortisol concentration at the end of the experiment was lower. V_1, MCR, and S were also significantly higher in the estradiol cypionate-injected group. There were no significant differences between the cortisol-injected group and the peanut oil-injected control group or in the biological half life of cortisol between any groups. (Authors)

11191. Windell, John T., David O. Norris, James F. Kitchell, and James S. Norris (Fish Physiology Lab., Univ. of Colorado, Boulder, Colo.). 1969. DIGESTIVE RESPONSE OF RAINBOW TROUT, Salmo gairdneri, TO PELLET DIETS. J. Fish. Res. Bd. Canada, 26(7): 1801-1812.

Quantitative data are presented for three laboratory experiments concerning rate of gastric evacuation of pellets (fed in gelatin capsules) and pellet components. Rainbow trout, Salmo gairdneri, acclimated to a constant water temperature of 15° C were killed 12 hours after consuming an experimental meal. Subtraction of amount of dry matter remaining at autopsy from dry matter consumed yielded amount of food digested or evacuated or both, from the stomach per unit time. Meals of encapsulated pellet were evacuated from the stomach more rapidly (65.8% decrease in 12 hours) than encapsulated corn oil (42.6%), gelatin (50.8%), a combination of corn oil and gelatin (47.3%), saturated fat (28.8%), or methyl cellulose (50.3%). Groups of fish consuming five capsules equal to approximately 0.65% of their body weight evacuated 35.9, 45.1, 64.2, 95.5, and 100% at intervals after killing from 6 to 36 hours, respectively. Similar groups consuming seven capsules equal to approximately 1.0% of their body weight evacuated 23.7, 57.9, 70.5, and 86.6% at intervals after killing from 4 to 20 hours, respectively. Ten

groups of trout consuming amounts of dry matter equal to 0.24, 0.40, 0.74, 1.11, 1.31, 1.19, 1.59, 1.56, 1.91, and 2.26% of their body weight evacuated 90.7, 81.3, 64.2, 57.9, 56.6, 52.5, 53.4, 51.3, 58.7, and 50.0% in 12 hours, respectively. Gastric motility remains relatively constant once food has entered the stomach. However, when larger meals are fed a greater quantity is evacuated per unit time. This could only be accomplished by changes in volume of gastric contents pumped per peristaltic stroke or number of strokes per unit time. (Authors)

11192. Savitz, Jan (Dept. of Zoology, Indiana Univ., Bloomington, Ind.). 1969. EFFECTS OF TEMPERATURE AND BODY WEIGHT ON ENDOGENOUS NITROGEN EXCRETION IN THE BLUEGILL SUNFISH (Lepomis macrochirus). J. Fish. Res. Bd. Canada, 26(7): 1813-1821.

The effects of temperature and body weight on endogenous nitrogen excretion (ENE) rate were examined for fish acclimated at 7.2, 15.6, 23.9, and 29.4-32.2° C. Nitrogen excretion rates were very high at the highest temperature and decreased with a decrease in acclimated temperature from 29.4-32.2° C to 15.6° C. Nitrogen excretion rates were equal at 15.6 and 7.2° C. From these data, an estimate of maintenance protein for a population of bluegill sunfish (Lepomis macrochirus) was calculated on a seasonal and yearly basis. (Auth.)

11193. Houston, A.H., Mary Anne DeWilde, and Jane A. Madden (Depts. of Biology and Physiology, Marquette Univ., Milwaukee, Wis.). 1969. SOME PHYSIOLOGICAL CONSEQUENCES OF AORTIC CATHETERIZATION IN THE BROOK TROUT (Salvelinus fontinalis). J. Fish. Res. Bd. Canada, 26(7): 1847-1856.

The effects of aortic catheterization upon the hematology and water-electrolyte regulation of brook trout have been followed for a period of 72 hours after completion of the procedure. The data indicate the markedly traumatic character of techniques of this general type, and the need for much longer recovery periods than have generally been allowed in studies on the cardiovascular physiology of salmonids. (Authors)

11194. Bilinski, E., and Y.C. Lau (Fish. Res. Board of Canada, Vancouver Lab., Vancouver, B.C., Canada). 1969. LIPOLYTIC ACTIVITY TOWARD LONG-CHAIN TRIGLYCERIDES IN LATERAL LINE MUSCLE OF RAINBOW TROUT (Salmo gairdneri). J. Fish. Res. Bd. Canada, 26(7): 1857-1866.

Lipolytic activity toward long-chain triglycerides was studied in the lateral line muscle of rainbow trout (Salmo gairdneri) by use of tissue slices. Emulsification of substrates with phospholipids was found to be necessary to demonstrate lipolysis, which occurred in decreasing intensity with tripalmitin, triolein, and tristearin. The lipolytic activity showed optimum activity at pH 7.3 and it was inhibited by NaF, protamine, and p-chloro-mercuriphenyl sulfonate. Albumin had little effect on the activity. Epinephrine did not stimulate lipolysis, but it reduced loss of activity during preincubation. (Authors)

11195. Symons, Philip E.K. (Fish. Res. Board of Canada Biological Sta., St. Andrews, N.B., Canada). 1969. GREATER DISPERSAL OF WILD COMPARED WITH HATCHERY-REARED JUVENILE ATLANTIC SALMON RELEASED IN STREAMS. J. Fish. Res. Bd. Canada, 26(7): 1867-1876.

When wild juvenile (parr) Atlantic salmon (Salmo salar L.) caught by electrofishing, and an equal number of hatchery-reared parr, matched for size with the wild ones, were released at three sites in unfamiliar streams containing resident parr, more hatchery-reared than wild parr could be observed by skin-diving in the areas 1 and 2 weeks later. Observed mortalities of wild parr were not sufficiently higher than those of hatchery parr to explain this result. Nor could a higher proportion of wild parr be found hiding compared with hatchery parr when one release site was electrofished a week after the release. Wild parr were found in greater numbers at points farther from one of the release sites than were hatchery-reared parr, and also more wild fish passed through a salmon counting fence approximately 100 m from a fourth release site than did hatchery-reared parr. Greater dispersal of wild parr would influence estimates of comparative survival between the two stocks. (Auth.)

11196. Wolfert, David R. (Bur. of Commercial Fisheries Biological Lab., Sandusky, Ohio). 1969. MATURITY AND FECUNDITY OF WALLEYES FROM THE EASTERN AND WESTERN BASINS OF LAKE ERIE. J. Fish. Res. Bd. Canada, 26(7): 1877-1888.

Of 2,427 walleyes (Stizostedion vitreum vitreum Mitchill)) examined from Lake Erie in 1964-66, no females were mature at ages below III and all were mature at age V. All male walleyes from the eastern basin were mature at age II, and those from the western basin at age III. Females from the western basin matured at a shorter length and a younger age than those from the eastern basin. Males from the western basin, on the other hand, matured at a longer length and greater age than those from the eastern basin. Egg production, which was estimated for 60 walleyes from the eastern basin and 78 from the western basin, ranged from 48,000 to 614,000. The number of eggs increased rapidly with increase in total length, but the relation between fecundity and weight was almost linear. Walleyes from the western basin were much more fecund for any given length, weight, or age than those from the eastern basin. Weight was the most accurate indicator of fecundity. The mean diameter of eggs from 32 ripe walleyes was 1.72 mm. Little relation existed between egg diameter and length or age of fish. (Auth.)

11197. Eales, J.G. (Dept. of Zoology, Univ. of Manitoba, Winnipeg, Man., Canada). 1969. A COMPARATIVE STUDY OF PURINES RESPONSIBLE FOR SILVERING IN SEVERAL FRESHWATER FISHES. J. Fish. Res. Bd. Canada, 26(7): 1927-1931.

The major purines occurring in silvery depositions were analysed for several taxonomically diverse species of freshwater fishes by paper chromatography and ultraviolet-spectrophotometry. Guanine and lesser quantities of hypoxanthine were the only purines found in the skin silvery layers of the channel catfish (Ictalurus punctatus), burbot (Lota lota), brook stickleback (Culaea inconstans), pike (Esox lucius), walleye (Stizostedion vitreum), sauger (S. canadense), goldfish (Carassius auratus), brook trout (Salvelinus fontinalis), and trout perch (Percopsis omiscomaycus). Possibly both guanine and hypoxanthine generally occur in fish skin silvery layers. In the pike and walleye the purines in the homogenized eye were examined and guanine and hypoxanthine recovered. However, for the swimbladder of pike, walleye, and channel catfish guanine alone was found. (Auth.)

11198. Paterson, Colin G. (Dept. of Biology, Univ. of Waterloo, Waterloo, Ont., Canada). 1969. OCCURRENCE OF Coregonus artedii AND C. zenithicus IN BARROW LAKE, ALBERTA. J. Fish. Res. Bd. Canada, 26(7): 1934-1939.

The variation in size at maturity and meristic characters of ciscoes inhabiting lakes in northern Alberta has made the assignment of specific names tenuous. Study of populations of Coregonus artedii and C. zenithicus in a small lake revealed that these two species can be effectively separated by gill-raker counts. A comparison with three other populations of C. artedii suggests that gill-raker counts will effectively distinguish these species in other northern Alberta lakes. (Auth.)

11199. Fromm, Paul O., and Robert C. Hunter (Dept. of Physiology, Michigan State Univ., East Lansing, Mich.). 1969. UPTAKE OF DIELDRIN BY ISOLATED PERFUSED GILLS OF RAINBOW TROUT. J. Fish. Res. Bd. Canada, 26(7): 1939-1942.

Transfer of dieldrin from environmental water into the vascular system of isolated perfused gills of rainbow trout was demonstrated. Transfer occurred only when plasma protein, or more probably plasma lipoprotein, was present in the perfusion fluid. Over the range of concentrations tested transfer was always down a concentration gradient. Larger quantities of dieldrin were absorbed on or bound in gills perfused with plasma than in those perfused with Ringer solution or a protein-free synthetic tissue culture medium (TC-199). (Authors)

11200. Dunn, R. S., and A. V. Tyler (Dept. of Biology, Acadia Univ., Wolfville, N. S., Canada). 1969. ASPECTS OF THE ANATOMY OF THE WINTER FLOUNDER OVARY WITH HYPOTHESES ON OOCYTE MATURATION TIME. J. Fish. Res. Bd. Canada, 26(7): 1943-1947.

Ovarian tissues of mature winter flounders have distinct groups of oocyte types which suggests that minimum of 2 or 3 years pass from the time that oocytes become histologically recognizable until they are spawned. (Authors)

11201. Schindler, D. W. (Fish. Res. Board of Canada, Freshwater Inst., Winnipeg, Man., Canada). 1969. TWO USEFUL DEVICES FOR VERTICAL PLANKTON AND WATER SAMPLING. J. Fish. Res. Bd. Canada, 26(7): 1948-1955.

Two devices for taking plankton and water samples are described. One, an inexpensive syringe sampler, will obtain small uncontaminated samples from thin strata in lakes. The other, a self-activating transparent zooplankton trap, combines many of the advantages of both net and trap-type samplers. It is capable of removing the smallest zooplankton and its light weight allows large samples to be taken easily from a small boat. Comparisons with other samplers prove the self-activating trap to be more efficient than other devices which are commonly used. (Auth.)

11202. Best, E. A., and Peter J. Eldridge (Internatl. Pacific Halibut Comm., Univ. of Washington, Seattle, Wash.). 1969. RANGE EXTENSION OF FLAG ROCKFISH (Sebastodes rubrivinctus) TO ALEUTIAN ISLANDS. J. Fish. Res. Bd. Canada, 26(7): 1955-1956.

During August 1967, 12 specimens of Sebastodes rubrivinctus were collected from the Pacific Ocean off Amchitka Island, Alaska. This is a westward extension of their known range from the Gulf of Alaska. (Authors)

11203. Magnuson, John J. (Bur. of Commercial Fisheries Biological Lab., Honolulu, Hawaii). 1969. DIGESTION AND FOOD CONSUMPTION BY SKIPJACK TUNA (Katsuwonus pelamis). Trans. Amer. Fish. Soc., 98(3): 379-392.

Skipjack tuna, 39-50 cm fork length, were studied during their first month in captivity in tanks 7.3 m in diameter and 1.1 m deep. Water temperatures were 23.3° to 25.7° C. Passage of food through the alimentary canal was estimated from 54 fish that were fed as many thawed smelt as they would eat. At intervals from 2 minutes to 24 hours later pairs of fish were removed and the wet and dry weights of the stomach and intestinal contents were measured. The fish ate the equivalent of about 8.6% of the body weight. About 10% of the original quantity eaten passed from the stomach each hour during the first 8 hours and the stomach was essentially empty within 12 hours after a meal. The content of the intestine reached a maximum after about 5 hours. The intestine was empty within 14 hours, but some of the food material moved into the digestive gland and apparently re-entered the intestine later. Blood glucose averaged 132 mg/100 ml blood from 0.5 to 7 hours after a meal but 81 mg/100 ml blood 10 to 24 hours after a meal. Food consumption was examined in relation to the quantity of food material in the stomach in three other experiments: (1) Skipjack tuna fed at intervals after a meal, began feeding before their stomachs emptied and even ate more than had already passed through from the stomach. For example, 4 hours after a meal they ate 75% of the amount eaten at the earlier meal, whereas only 50% of the earlier meal had emptied from the stomach. (2) Skipjack tuna were fed at 15-minute intervals throughout the day. Although a period of intense feeding occurred between 0630 and 0830 hours, the fish did not fill their stomachs to capacity the first or even the second or third time they were offered food, but filled their stomachs slowly over the 2-hour period. Maximum capacity of the stomach was about 7% of the fish's weight, but during the whole day they ate an equivalent of 15% of their body weight. Skipjack tuna ate more food and digested it more rapidly than other fishes for which data are published. (3) The response to food were observed as the fish ate and their stomachs filled. The proportion of food particles attacked decreased after the stomach was half filled and the percentage of food particles to which the fish responded began to decrease after the stomach was about 80% full. The results

are discussed in relation to the effects of satiation of the food drive on pole-and-line fishing for skipjack tuna near Hawaii, and the relation between feeding motivation and the quantity of food in the stomach. (Auth.)

11204. Laarman, Percy W. (Michigan Dept. Natural Resources, Inst. for Fish. Res. Museums Annex, Ann Arbor, Mich.). 1969. EFFECTS OF A LIMITED FOOD SUPPLY ON GROWTH RATES OF COHO SALMON AND STEELHEAD TROUT. Trans. Amer. Fish. Soc., 98(3): 393-397.

Competition between coho salmon and steelhead trout was studied by comparing specific growth rates of the two species in a laboratory raceway. The raceway was partitioned into six test compartments, each 1.5 m long by 35.5 cm wide; each compartment had flowing water of about 200 liters per minute with temperature averaging 13.9° C and dissolved oxygen 6.5 ppm. Fingerling salmon and trout of similar size were compared, and tests were run on fingerlings 58 to 76 mm in length and also on fingerlings 91 to 105 mm long. The fish were fed the Oregon moist pellet from Oct. 5 to Dec. 20, 1967. Daily feeding rates were kept below optimum and ranged from 1.8% to 3.6% of body weight. When trout and salmon below 84 mm were held together in the same raceway, the trout grew at a significantly faster rate; in other words steelhead trout were dominant over coho salmon in utilizing food from a limited supply. Above 84 mm, the growth rate of the experimental trout was also greater than that of the salmon, although the difference was not significant at the 95% confidence level. Specific growth rates were dependent on the initial sizes of the fish. (Auth.)

11205. Laurence, Geoffrey C. (Dept. of Conservation, Cornell Univ., Ithaca, N.Y.). 1969. THE ENERGY EXPENDITURE OF LARGEMOUTH BASS LARVAE, Micropterus salmoides, DURING YOLK ABSORPTION. Trans. Amer. Fish. Soc., 98(3): 398-405.

This research was designed to determine if a metabolic energy deficit was a cause of mortality in larval largemouth bass (Micropterus salmoides). An energy budget was established which compared the energy available in the yolk to the energy utilized in catabolism for 24-hour intervals from the time of fertilization to complete yolk absorption. The energy available to an embryo or larva was calculated from the caloric value of the yolk present at a given time. Catabolic expenditures of energy were determined by two different methods. The first was to establish the day-to-day dry weight loss of the larvae and convert this to an energy expenditure value. The second method used oxygen consumption at a constant temperature as a measure of catabolism. The dry weight method revealed that the average larva had enough energy remaining in the yolk to meet developmental and catabolic requirements until a slight deficit did not occur at a critical time in larval development, however, since observations indicated that over 50% of the larvae were capable of feeding by 288 hours. The oxygen consumption method showed that the average larva did not incur an energy deficit at any time prior to complete yolk absorption. (Auth.)

11206. Thomas, Allan E., Joe L. Banks, and Donald C. Greenland (Bur. of Sport Fisheries and Wildlife, Salmon-Cultural Lab., Longview, Wash.). 1969. EFFECT OF YOLK SAC ABSORPTION ON THE SWIMMING ABILITY OF FALL CHINOOK SALMON. Trans. Amer. Fish. Soc., 98(3): 406-410.

Tests were made of the swimming ability of fall chinook salmon (Oncorhynchus tshawytscha) during and after yolk sac absorption. Two sources of fish were used: hatchery fish incubated and reared in constant-temperature well water and migrants from an incubation channel supplied with creek water of variable temperature. Two testing procedures were used: impingement tests using a fixed screen and constant water velocities with percent impinged as the measure, and stamina tests using increases in water velocities at fixed intervals with time of displacement as the measure. As the fish developed, a period of reduced swimming ability occurred shortly before complete yolk sac absorption. The slump coincided with the period of peak migration from the channel and may be a cause of migration and an important factor in survival. (Authors)

11207. Barnhart, Roger A. (Bur. of Sport Fisheries and Wildlife, California Coop. Fish. Unit., Humboldt State College, Arcata, Calif.). 1969. EFFECTS OF CERTAIN VARIABLES ON HEMATOLOGICAL CHARACTERISTICS OF RAINBOW TROUT. Trans. Amer. Fish. Soc., 98(3): 411-418.

Rainbow trout of two strains (Shasta and Idaho) were fed two diets (Colorado and Santa Monica) under experimental conditions. The effects of diet, strain, sex, and age on total blood cell count, hematocrit, hemoglobin, sedimentation rate, bilirubin, alkaline phosphatase, glutamic-oxalacetic transaminase, total protein, glucose, cholesterol, creatinine, and uric acid were measured. No sex-related differences were detected in hematological values. Variations due to time appeared to be random. Variations due to diet, strain, and/or diet-strain interactions were found for many of the blood components. There were differences in several tests between hematological characteristics of "wild" and cultured trout. Hematological effects of diet, strain, age, water temperature, sampling techniques, and test methods were important, and should be considered by researchers. The range of mean values obtained for the blood components measured can be used as "normal" levels for comparison if investigators employ similar conditions and techniques. (Auth.)

11208. Amend, Donald F., William T. Yasutake, and Reginald Morgan (Western Fish Disease Lab., Bur. of Sport Fisheries and Wildlife, Seattle, Wash.). 1969. SOME FACTORS INFLUENCING SUSCEPTIBILITY OF RAINBOW TROUT TO THE ACUTE TOXICITY OF AN ETHYL MERCURY PHOSPHATE FORMULATION (TIMSAN). Trans. Amer. Fish. Soc., 98(3): 419-425.

This study determined the influence of water temperature (55-68° F), dissolved oxygen (4-12 ppm), water hardness as $CaCO_3$ (20-256 ppm), and chloride ions (to 2 mM) on the susceptibility of rainbow trout (Salmo gairdneri) to the acute toxicity of ethyl mercury phosphate (EMP). The fish were exposed for one hour to 0.125 ppm EMP, the active ingredient of Timsan, a commercial EMP formulation. The death rate because of the exposure to EMP increased with an increase in water temperature, a decrease in dissolved oxygen, and an increase in chloride ions; calcium appeared to have no effect. The effect of water temperature and dissolved oxygen was ascribed to changes in the respiration rate of the fish, and a chemical explanation is presented for the effect of chloride ions. (Authors)

11209. Hansen, David J. (Bur. of Commercial Fisheries Biological Field Sta., Gulf Breeze, Fla.). 1969. AVOIDANCE OF PESTICIDES BY UNTRAINED SHEEPSHEAD MINNOWS. Trans. Amer. Fish. Soc., 98(3): 426-429.

The capacity of sheepshead minnows, Cyprinodon variegatus, to avoid six pesticides (DDT, endrin, malathion, Dursban, Sevin, and 2, 4-D) was investigated. Test fish avoided water containing DDT, endrin, Dursban, and 2, 4-D. The fish did not avoid the test concentrations of malathion or Sevin. When fish were exposed simultaneously to two different concentrations of the four pesticides that were avoided, they avoided the highest concentration of 2, 4-D but preferred the higher concentration of DDT. Fish did not discriminate between other concentrations of 2, 4-D or between different concentrations of endrin or Dursban. (Auth.)

11210. Wilson, Dennis, C., and Carl E. Bond (Dept. of Fisheries and Wildlife, Oregon State Univ., Corvallis, Oreg.). 1969. THE EFFECTS OF THE HERBICIDES DIQUAT® AND DICHLOBENIL (CASORON®) ON POND INVERTEBRATES. PART I. ACUTE TOXICITY. Trans. Amer. Fish. Soc., 98(3): 438-443.

The median tolerance limits (TL_m) of Diquat (1:1-ethylene-2:2' dipyridylium dibromide) and Dichlobenil (2, 6-dichlorobenzonitrile) to one amphipod and larvae of five species of aquatic insects were determined. Diquat was over 300 times more toxic to the amphipod (Hyalella azeteca) than to the mayfly (Callibaetis sp.) while the caddisfly (Limnephilus sp.), tendipedid (Tendipedidae), damselfly (Enallagma sp.), and dragonfly (Libellula sp.) in that order, were more resistant. The addition of pond mud to the test vessels changed the 96-hour TL_m of Diquat for the amphipod from 0.046 to 6.8 mg/liter. Dichlobenil was less toxic than Diquat to the amphipod but more toxic to the aquatic insects. Dichlobenil was less

toxic than Diquat to the amphipod but more toxic to the aquatic insects. Dichlobenil had a narcotizing effect that was recorded as an immobilization concentration (IC_{50}). The addition of pond mud did not reduce the toxicity of Dichlobenil to the caddisfly. The 4% granular formulation of Dichlobenil had a 72-hour "lag" before an effective concentration was obtained equivalent to the toxic effect of the 50% wettable powder. Dichlobenil formed a strong layer at the bottom of the test vessel and was more toxic with time to the invertebrates than to the fishes Micropterus salmoides and Lepomis macrochirus. (Authors)

11211. Hale, John G., and Donald A. Hilden (Fed. Wat. Pollut. Control Admin., Natl. Water Quality Lab., Duluth, Minn.). 1969. SPAWNING AND SOME ASPECTS OF EARLY LIFE HISTORY OF BROOK TROUT, Salvelinus fontinalis (Mitchill), IN THE LABORATORY. Trans. Amer. Fish. Soc., 98(3): 473-477.

Brook trout spawning, egg incubation and survival, and emergence of the fry were observed in 1967 in rectangular and circular tanks at the National Water Quality Laboratory, Duluth, Minnesota. Sexually mature wild brook trout were placed in experimental spawning tanks 24, 72 and 240 hours after collection. Provided with a gravel substrata and a flow of 4 to 7 liters per minute, these trout spawned in the laboratory. It appeared that, the longer the sexually mature wild brook trout were held before exposure to a spawning facility, the longer the spawning period. A choice of water flowing horizontally through and over the gravel or an upwelling of water simulating "ground water" was offered the trout in the experimental tanks. It was found that an upwelling of water through the gravel is not necessary for brook trout spawning, egg survival or emergence of the fry in the laboratory. However, survival to the fry stage appeared to be higher where there was an upwelling of water than where it was lacking. Fry hatched in the gravel started feeding more readily and, at the end of the first 3 months of feeding, averaged 17% heavier than those hatched in the incubator. (Authors)

11212. Finucane, John H. (Bur. of Commercial Fisheries Biological Lab., St. Petersburg Beach, Fla.). 1969. ECOLOGY OF THE POMPANO (Trachinotus carolinus) AND THE PERMIT (T. falcatus) IN FLORIDA. Trans. Amer. Fish. Soc., 98(3): 478-486.

Ecological data are given for young-of-the-year pompano and permit collected in the Tampa Bay, Florida, area for 1962 and 1963. Additional data are included from stocks in the Tampa Bay and St. Augustine areas of Florida in 1967 and 1968. Distribution, seasonal occurrence, abundance, spawning, growth rates, food preferences, parasites and disease are included for each species. The occurrence of these fish with respect to water temperature, salinity, oxygen, and pH is discussed. (Auth.)

11213. Haw, Frank, and Stephen B. Mathews (Washington Dept. of Fisheries, Olympia, Wash.). 1969. RECREATIONAL USE OF SURPLUS HATCHERY COHO SALMON. Trans. Amer. Fish. Soc., 98(3): 487-496.

Returning surplus adult coho salmon (Oncorhynchus kisutch), principally sexually precocious males (jacks), were confined in 1,500 feet of stream adjacent to the Washougal River salmon hatchery near Camas, Washington. To increase the benefits from hatchery production, the Washington Department of Fisheries then opened the area to free fishing. Regulations restricted fishing gear to rod, hook and line, and made retention of all salmon caught mandatory regardless of whether they were hooked inside the mouth or outside the mouth (snagged). Catch and fishing effort estimates were obtained from interviews, automobile counts and streambank sampling. Economic data and the opinions of fishermen and observers regarding the fishery were also obtained from interviews. During the 41-day season extending from September 21 through October 31, 1967, 14,689 fishermen trips resulted in a catch of 22,749 jacks and 9,552 3-year-old coho salmon weighing a total of 136,883 pounds. Most of these fish were snagged. The net economic value of this recreational fishery was estimated to be substantially more than the net value that would have resulted from the alternative of selling the fish to a commercial buyer. Participating fishermen and observers were largely in favor of the special fishery. (Authors)

11214. Whitney, Richard R. (Fishery Oceanography Center, Bur. of Commercial Fisheries, La Jolla, Calif.). 1969. SCHOOLING OF FISHES RELATIVE TO AVAILABLE LIGHT. Trans. Amer. Fish. Soc., 98(3): 497-504.

Laboratory studies are reviewed that showed fishes stopped schooling at particular light intensities. These are related to light intensities expected in natural waters. Two figures illustrate the attenuation of total energy from noon sun, moonlight, starlight and skylight, and so forth, and show the differences in the fraction of total energy which is visible at different depths in (1) clearest natural water and (2) typical coastal water. Energy visible photopically and scotopically are shown in separate curves. Maximum depths for fish schooling are indicated on these curves. This is only possible if several assumptions can be made. Effects of bioluminescence on fish schooling can only be speculated upon, but at times it probably makes it possible for fish to maintain schools visually. Studies are required to test the assumptions that have to be made in relating laboratory studies to natural conditions. Studies of the effects of bioluminescence on fish schooling are required. (Auth.)

11215. Walters, Carl J. (Colorado Coop. Fish. Unit., Colorado State Univ., Fort Collins, Colo.). 1969. A GENERALIZED COMPUTER SIMULATION MODEL FOR FISH POPULATION STUDIES. Trans. Amer. Fish. Soc., 98(3): 505-512.

A generalized computer model for fish population simulation and maximum yield determination is described. The model utilizes age-specific natural mortality, rates, growth rates, relative fecundities, and any desired stock-recruitment relationship. Best harvest strategies are found by treating long-term yield as a response surface on the set of age- and year-specific fishing rates. The model is illustrated using data on arctic cod, stream brook trout, and on a hypothetical population with strong age-class dominance. Best predicted management strategies include periodic harvest when age at entry to the fishery cannot be controlled, but maximum yield is usually obtained with constant fishing rate. (Auth.)

11216. Raymond, Howard L. (Bur. of Commercial Fisheries Biological Lab., Seattle, Wash.). 1969. EFFECT OF JOHN DAY RESERVOIR ON THE MIGRATION RATE OF JUVENILE CHINOOK SALMON IN THE COLUMBIA RIVER. Trans. Amer. Fish. Soc., 98(3): 513-514.

11217. Jenkins, Thomas M., Jr. (Bur. of Sport Fisheries and Wildlife, Sierra Nevada Aquatic Research Lab., Bishop, Calif.). 1969. OBSERVATIONS ON COLOR CHANGES OF BROWN AND RAINBOW TROUT (Salmo trutta AND S. gairdneri) IN STREAM HABITATS, WITH DESCRIPTION OF AN UNUSUAL COLOR PATTERN IN BROWN TROUT. Trans. Amer. Fish. Soc., 98(3): 517-519.

11218. Behmer, David J. (Iowa Coop. Fish. Unit, Iowa State Univ., Ames, Iowa). 1969. SCHOOLING OF RIVER CARPSUCKERS AND A POPULATION ESTIMATE. Trans. Amer. Fish. Soc., 98(3): 520-523.

11219. Behmer, David J. (Dept. of Biology, Lake Superior State College, Sault Ste. Marie, Mich.). 1969. A METHOD OF ESTIMATING FECUNDITY; WITH DATA ON RIVER CARPSUCKERS, Carpiodes carpio. Trans. Amer. Fish. Soc., 98(3): 523-524.

11220. Phillips, Gary L. (Dept. of Zoology, Univ. of Minnesota, Minneapolis, Minn.). 1969. ACCURACY OF FECUNDITY ESTIMATES FOR THE MINNOW Chrosomus erythrogaster (CYPRINIDAE). Trans. Amer. Fish. Soc., 98(3): 524-526.

11221. Flickinger, Stephen A. (Colorado Coop. Fish. Unit, Colorado State Univ., Fort Collins, Colo.). 1969. DETERMINATION OF SEXES IN THE FATHEAD MINNOW. Trans. Amer. Fish. Soc., 98(3): 526-527.

11222. Richards, William J., and Barbara J. Palko (Bur. of Commercial Fisheries, Tropical Atlantic Biological Lab., Miami, Fla.). 1969. METHODS USED TO REAR THE THREAD HERRING, Opisthonema oglinum, FROM FERTILIZED EGGS. Trans. Amer. Fish. Soc., 98(3): 527-529.

11223. Woods, C. S. (Dept. of Zoology, Univ. of Manitoba, Winnipeg, Man., Canada). 1969. A FISH MEASURING BOARD WITH DOUBLE VERNIER. Trans. Amer. Fish. Soc., 98(3): 529-532.

11224. Cook, S. F., Jr., and R. L. Moore (Dept. of Zoology, Univ. of California, Davis, Calif.). 1969. THE EFFECTS OF A ROTENONE TREATMENT ON THE INSECT FAUNA OF A CALIFORNIA STREAM. Trans. Amer. Fish. Soc., 98(3): 539-544.

11225. Paulik, G. J. (Center for Quantitative Sci. in Forestry, Fish., and Wildlife, Univ. of Washington, Seattle, Wash.). 1969. COMPUTER SIMULATION MODELS FOR FISHERIES RESEARCH, MANAGEMENT, AND TEACHING. Trans. Amer. Fish. Soc., 98(3): 551-559.

Recent and current activities involving large-scale computer simulation models in fisheries science and related areas of applied ecology are reviewed. Selected general references to computer modeling and simulation as well as specific references in resource management and ecology are given. Two types of existing models are described—those developed for investigating benefits and cost of fishery management policies and those for studying fundamental properties of natural animal communities. Use of simulated resource management games as Link trainers to provide students with the type of learning experience that now requires several years in responsible management positions is discussed. It is predicted that the resource management agency of the future will maintain a hierarchy of simulation models to serve as basic planning tools for studying total system response to natural and artificial change. (Auth.)

11226. Saila, S. B., and J. M. Flowers (Graduate School of Oceanography, Univ. of Rhode Island, Kingston, R. I.). 1969. TOWARD A GENERALIZED MODEL OF FISH MIGRATION. Trans. Amer. Fish. Soc., 98(3): 582-588.

Recent research utilizing mathematical approaches to marine fish migration problems is critically reviewed. An analogy between the diffusion of organisms and physical quantities is drawn, and the well-known heat diffusion equation is examined as a possible general model for migration. Specific solutions to this equation under various boundary conditions utilizing empirically determined movement parameters derived from tagging and recapture data are obtained utilizing digital computer techniques. Available data are examined with a view toward suggesting the relative significance of the coefficients of directed movement and dispersion under various conditions. The possible mechanisms involved are briefly considered and the utility of the model in testing various hypotheses regarding the precision of the orientation is demonstrated. (Authors)

11227. Trefethen, Parker S. (Bur. of Commercial Fisheries, Fresh Water and Estuarine Research, Seattle, Wash.). 1968. FISH-PASSAGE RESEARCH. REVIEW OF PROGRESS, 1961-66. Bureau of Commercial Fisheries Circular 254. 24 p. Illus.

Results of accelerated laboratory and field experiments to investigate problems of anadromous fish passage at high dams are summarized. Studies were made on: the passage of adult and juvenile fish through large, medium, and small impoundments; design and operation of adult fish-passage facilities at dams; mortalities of juvenile fish passing through turbines and methods of reducing losses; collection of juvenile fish from rivers, streams, and reservoirs; transportation of juvenile fish; and the effect of the changing environment on passage and survival. Publications by the staff are listed. (Auth.)

11228. Deufel, Josef (Staatlichen Institut für Seeforschung und Seenbewirtschaftung, Langenargen, Germany). 1967. DIAGNOSE AND CONTROL OF FURUNCULOSIS IN TROUT HATCHERIES. (Zur Diagnose und Bekämpfung der Furunkulose in Forellenzuchtanstalten). Osterreichs Fischerei, 20(10): 1-4.

During the past eight years, 100 cases of furunculosis have been observed in southern Germany. Four disease forms are described; ulcerative, fin and skin hemorrhage form, "intestinal form", and asymptomatic. It is noted that only 10% of the cases showed the ulcerative form from which the disease got its name. About 20% of the first two forms showed mixed infections. Environmental stress is indicated as an important factor. Several drugs have proven effective: 300 gm sulfamerazine + 90 gm sulfaguanidine/100 kg food for 10 days; 0.1-0.2% Terramycin, Aureomycin, Chloramphenicol, or zinc bacitracin in the feed for 10 days; 0.2% Furoxone in the feed for 10 days. Resistance to the sulfas and the antibiotics has been observed. To date, strains have shown no resistance to Furoxone. Zinc bacitracin has proven effective as a prophylaxis (0.01% of feed); however, it reduces fish growth and increases frequency of drug resistance. It should be fed only during dangerous periods. --Roger L. Herman.

11229. Rowland, Richard G. (Bur. of Commercial Fisheries Biological Lab., Auke Bay, Alaska). 1969. RELATION OF SCALE CHARACTERISTICS TO RIVER OF ORIGIN IN FOUR STOCKS OF CHINOOK SALMON (Oncorhynchus tshawytscha) IN ALASKA. Bureau of Commercial Fisheries Special Scientific Report--Fisheries No. 577. 5 p.

Differences in numbers of circuli and lengths of radii through the first freshwater annulus were used to test the hypothesis that the river of origin could be determined from these characteristics. Analyses indicated that males and females and different age groups of a brood year could be combined for each river, but that comparisons between rivers should be restricted to common brood years. Although average counts of circuli and average lengths of radii were different in samples from each river, the variability in these characteristics is great, and neither characteristic is clearly diagnostic for the stock in any of the rivers. (Auth.)

11230. Thomas, James C. 1968. MANAGEMENT OF THE WHITE SEABASS (Cynoscion nobilis) IN CALIFORNIA WATERS. California Dept. of Fish and Game Fish Bulletin 142. 34 p. Illus.

Analyses of the white seabass commercial fishery and the regulations governing it revealed that management techniques in use since 1931 have probably affected the yield. Values from catch-per-unit-of-effort, weight-length, age-growth, and population parameters were utilized in an equation to determine the best possible equilibrium yield under existing environmental, biological, and socio-economic conditions. Results indicate that under present fishery practices (namely, fishing on only a portion of the resource) the yield in weight per recruit could be increased if actual harvesting were to begin at age 5 (28 inches TL). Current regulations have sufficient latitude to permit the fishery, on its own volition, to harvest younger fish, namely 5- to 8-year-olds rather than 8- to 11-year-olds. (Auth.)

11231. Brown, George W., and James T. Krygier. 1967. CHANGING WATER TEMPERATURES IN SMALL MOUNTAIN STREAMS. J. Soil Water Conserv., 22(6): 242-244.

The effect of clearcutting on the water temperature of mountain streams with small volumes of flow may be extremely significant in the management of Pacific Northwest watersheds. These small streams provide a major portion of the spawning areas for salmon, steelhead and trout. Many such streams supply water to small municipalities and rural water districts. In both instances, considerations of water quality may play a major role in determing management guidelines. Clearcutting influences summer stream temperature. The integrated effect of numerous clearcuttings on small tributary streams of larger stream systems may be as significant as dams and other sources of thermal pollution. (Authors summ.)

11232. Drahos, Nick. 1968. FISH WITH A FUTURE. THE SILVER (COHO) SALMON. The Conservationist, 22(5): 2-3.

On January 31, 1968, New York made an initial stocking of 6,000 coho salmon, 5 to 6 inches long, in Cattaraugus Creek which flows into Lake Erie. It is hoped these salmon will go down into the lake in the spring of 1968 and return to Cattaraugus Creek as spawners in the fall of 1969. Another 200,000 coho will be stocked by New York in suitable waters during the spring of 1969.

11233. Oliva, Ota, and Vlastislav Skorepa. 1969. THE EYE MUSCLES IN COD, Gadus morhua callarias Linnaeus AND BURBOT, Lota lota (Linnaeus). Vestn. Cesk. Spolecnosti Zool., 33(1): 34-39.

The eye muscles of the cod (Gadus) and burbot (Lota) are not inserted in myodomes. In the cod the oblique eye muscles are longer than recti muscles, in the burbot, on the contrary, the obliqui muscles are shorter than the recti. (Authors)

11234. Stehlik, Josef. 1969. THE FECUNDITY OF PERCH, Perca fluviatilis (Linnaeus, 1758) IN THE KLICAVA WATER RESERVOIR. Vestn. Cesk. Spolecnosti Zool., 33(1): 88-95.

This work should contribute to recognition of the perch reproduction biology in the water reservoir at Klicava. The data about fecundity, the period of the sexual maturation as well as data concerning the ripeness coefficient of the sexual glands of males and females are being shown here. An average absolute fecundity of 14,127 eggs was stated at 61 females taken between April 23 and May 1, 1964, of body-length 115-330 mm, body-weight 40-1,103 g. (Auth.)

11235. University of Washington, College of Fisheries. 1968. 1967 RESEARCH IN FISHERIES. University of Washington, College of Fisheries, Fisheries Research Institute Contribution No. 280. 82 p.

General subjects covered are: high seas salmon studies, Alaskan salmon research, Washington fish studies, invertebrate fisheries, radioecology, ecology and water utilization, and food science.

11236. Mueller, Marti. 1969. DDT: CRITICISM, CURBS ARE ON THE UPSWING. Science, 164(3882): 936-937.

Recent government actions, to limit or ban the use of DDT and to investigate the broad general effects of pesticide use in the environment, could lead to whole new concepts about how pesticides should be used.

11237. Reigner, Irvin C., William E. Sopper, and Roy R. Johnson. 1968. WILL THE USE OF 2, 4, 5-T TO CONTROL STREAMSIDE VEGETATION CONTAMINATE PUBLIC WATER SUPPLIES? J. Forest., 66(12): 914-918.

Riparian vegetation along two small headwater streams in Pennsylvania and New Jersey was treated with 2, 4, 5-T. Water samples were collected immediately after treatment and periodically thereafter for three weeks. Odor tests were used to determine the degree of contamination. Results indicated that only slight contamination occurred within the treated sections of streams immediately after treatment and in two instances after the first large storm. No contamination was detected downstream. Vegetation analysis one year after treatment indicated that the ester formulation had completely killed 70 to 81 percent of the stems and that the emulsifiable acid had killed 58 to 78 percent. Results of this study provide additional evidence that phenoxy herbicide, if applied with normal precautions, can be used on municipal watersheds without creating any water contamination. (Authors)

11238. Burrows, Charles R. 1969. OUR WALLEYES AND THE SUCKER GAME. The Conservation Volunteer, 32(186): 17-20. Minnesota Conservation Dept., St. Paul.

A heavy harvest of white suckers from one Minnesota lake has considerably increased the population of walleyes and perch, a favorite food of the walleye.

11239. Johnson, Leon D. 1969. FOOD OF ANGLER-CAUGHT NORTHERN PIKE IN MURPHY FLOWAGE. Wisconsin Dept. of Natural Resources Technical Bulletin Number 42. 26 p. Illus.

Nine years of stomach contents analysis on angler-caught northern pike have shown that pike will indeed feed on bluegills. Bluegills, perch, minnows and crappies, in that order, were the major prey species of the northerns in Murphy Flowage. Although bluegills were the predominant prey species, a more important fact for fish management is that pike took perch more frequently than bluegills in proportion to their abundance. Assuming that this also holds in other lakes, it is very doubtful that northern pike predation can control bluegill populations when perch or other cylindrical fish are present. All sizes of northern pike are able to take larger prey than the majority of them did. Their heavy use of small forage fishes is not immediately explainable but probably has a direct influence on the size of the pike themselves. This tendency to take small prey when it is available may result in limiting the growth of northerns in some lakes. Body depth of the forage fish is the critical dimension influencing predation. Feeding was not related to the presence or absence of food in the stomach. Northern pike feed continuously during daylight hours, so fishermen would likely find one time of day as good as any other for catching them. Small minnows and midwater lures were the most successful baits. (Auth. summ.)

11240. Brannon, E. L. 1967. GENETIC CONTROL OF MIGRATING BEHAVIOR OF NEWLY EMERGED SOCKEYE SALMON FRY. Int. Pac. Salmon Fish. Comm. Progress Report No. 16. 31 p.

Genetic control of migrating behavior in response to current was investigated in newly emerged sockeye salmon fry. Fertilized eggs from three races, representing stocks from outlet streams, inlet streams and lake incubation areas of the Fraser River system, were hatchery incubated under controlled conditions very different from their natural environments. The resulting alevins and fry were tested to determine their preferred direction of migration, and each race responded to current with the same behavior pattern exhibited in its natural environment. Although the innate response to current was not influenced by age of the fry or by temperature, the source of water (lake or creek) was shown to have a marked effect on the response of certain races. The implications of a genetic control of fry migrating behavior are discussed with regard to fisheries management. (Auth.)

11241. Hurley, D. A., and E. L. Brannon. 1969. EFFECT OF FEEDING BEFORE AND AFTER YOLK ABSORPTION ON THE GROWTH OF SOCKEYE SALMON. Int. Pac. Salmon Fish. Comm. Progress Report No. 21. 19 p.

The present study was carried out to determine how soon after hatching sockeye salmon (Oncorhynchus nerka) alevins would consume food and the effect of food consumption on subsequent growth. Six groups of alevins were reared under experimental conditions and the first food was introduced at different stages of development from just after hatching to beyond complete yolk absorption. Although alevins would eat very soon after hatching, food consumption prior to yolk absorption did not increase growth as compared with alevins held without feeding until yolk was completely used. However, when food was withheld until about a week after complete yolk absorption, subsequent growth was somewhat retarded. Alevins fed before yolk absorption appeared to consume larger quantities of food later in development than those denied food until yolk was absorbed. Also, if fry were denied food until well beyond absorption, some refused to feed altogether. Thus although growth was not influenced by early feeding under these experimental circumstances, it is suggested that early association with food could influence feeding behavior through learning. (Authors)

11242. Department of Fisheries, FAO of the UN (Rome, Italy). 1969. DIRECTORY OF FISH CULTURE RESEARCH INSTITUTIONS. FAO Fish. Tech. Paper No. 85.

This Directory lists those institutions with a continuing program of research related to the culture of fish and other aquatic organisms.

11243. Priegel, Gordon R. 1969. THE LAKE WINNEBAGO SAUGER. AGE, GROWTH, REPRODUCTION, FOOD HABITS AND EARLY LIFE HISTORY. Wisconsin Dept. of Natural Resources Tech. Bull. No. 43. 63 p.

The abundant but little known sauger in Lake Winnebago was studied from 1957-1967 to obtain life history information. Age and growth information is based on 1,824 saugers. A large range of length in each age group and resulting overlap of age groups makes length a poor index of age. Calculated lengths for male and female saugers are not significantly different beyond the second year. Both sexes of Lake Winnebago saugers made their greatest annual growth in length (4.9 inches for males and 5.3 inches for females) during the first year of life. The largest weight increments (0.23 pound for males and 0.22 pound for females) came in the third year. There was no significant difference in weight between the sexes. Only one fish surpassed 2 pounds and only 95 exceeded 1 pound. Male saugers were mature at the end of the second year of life, and females at the end of the fourth year. Few saugers lived beyond 5 years in Lake Winnebago. The average number of eggs per ovary for saugers 10.1 to 14.6 inches in total length was 15,871 eggs. Spawning was initiated at a water temperature of 43° F, which occurs in late April to early May, and occurred over a sand and gravel substrate along the north shore. The external characteristic used to distinguish between 1- to 3-inch walleyes and saugers of the same size was the abundance or lack of melanophores on the dorsal surface of the head. Saugers less than 50 mm were considered plankton feeders; yearling and older saugers relied heavily on forage fish for food items. Troutperch were the preferred forage fish, although young and yearling freshwater drum were also a major food item. Trawling with small mesh trawls provided reliable data for determining year class strength for young saugers. Year-class strength is usually set by late September or October. Saugers in Lake Winnebago could support a greater harvest. The population is short-lived, very stable and can attain high levels. (Auth.)

11244. Bureau of Commercial Fisheries. 1968. RESEARCH FACILITIES OF THE RADIOBIOLOGICAL LABORATORY, BUREAU OF COMMERCIAL FISHERIES, BEAUFORT, NORTH CAROLINA. Bureau of Commercial Fisheries Circular 298. 17 p.

The Radiobiological Laboratory is supported jointly by the Bureau of Commercial Fisheries and the U.S. Atomic Energy Commission. The history, facilities, and organization are discussed. Research is performed on estuarine ecology, biogeochemistry, pollution, and effects of radiation.

11245. Hanamura, N. (Hokkaido Regional Fisheries Research Lab., Hakodate, Japan). 1967. SALMON OF THE NORTH PACIFIC OCEAN—PART IV. SPAWNING POPULATIONS OF NORTH PACIFIC SALMON. 1. SOCKEYE SALMON IN THE FAR EAST. Int. North Pac. Fish. Comm. Bull. 23, pp. 1-7.

11246. Ishida, T. (Hokkaido Regional Fisheries Research Lab., Hakodate, Japan). 1967. SALMON OF THE NORTH PACIFIC OCEAN—PART IV. SPAWNING POPULATIONS OF NORTH PACIFIC SALMON. 2. PINK SALMON IN THE FAR EAST. Int. North Pac. Fish. Comm. Bull. 23, pp. 9-22.

11247. Sano, S. (Hokkaido Salmon Hatchery, Sapporo, Japan). 1967. SALMON OF THE NORTH PACIFIC OCEAN—PART IV. SPAWNING POPULATIONS OF NORTH PACIFIC SALMON. 3. CHUM SALMON IN THE FAR EAST. Int. North Pac. Fish. Comm. Bull. 23, pp. 23-41.

11248. Atkinson, C.E., J.H. Rose, and T.O. Duncan (Bur. of Commercial Fisheries Biological Lab., Seattle, Wash.). 1967. SALMON OF THE NORTH PACIFIC OCEAN—PART IV. SPAWNING POPULATIONS OF NORTH PACIFIC SALMON. 4. PACIFIC SALMON IN THE UNITED STATES. Int. North Pac. Fish. Comm. Bull. 23, pp. 43-223.

11249. Aro, K. V., and M. P. Shepard (Fish. Res. Board of Canada Biological Station, Nanaimo, B. C., Canada). 1967. SALMON OF THE NORTH PACIFIC OCEAN—PART IV. SPAWNING POPULATIONS OF NORTH PACIFIC SALMON. 5. PACIFIC SALMON IN CANADA. Int. North Pac. Fish. Comm. Bull. 23, pp. 225-327.

11250. Kempinger, James J. 1969. EXPERIMENTAL MANAGEMENT OF SPRUCE LAKE, A SMALL BOG LAKE IN NORTHEASTERN WISCONSIN. Wisconsin Dept. of Natural Resources Research Report 40. 13 p.

The effects of four management procedures have been studied for 22 years on Spruce Lake, a bog lake in northeastern Wisconsin with an overcrowded panfish population: liberalized regulations, maintenance stocking, closed seasons, and chemical reclamation and restocking. Neither the liberalized regulations nor the 3-year closed season improved the fishing quality on Spruce Lake. In contrast, chemical treatment and restocking produced a greatly improved fishery, with double the rate of angling success. (Auth.)

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